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Al-Wali Clinical & Radiological Orthopaedic Examination

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Chapter 1
Guidelines To Orthopaedics

Practical knowledge for students of 5th year

The student at the end of this course should know:

1. Routine for clinical examination:

Listen to what the patient tells you:

LOOK Gait Posture Attitud rea ***Inspection:…………*** Skin Soft tissue Bone

FEEL gently for swelling, painful area, temperature changes and Tenderness (skin, soft tissue, bone) ***Palpation:…………***

limb length and girth. ***Measure:…………***

Movement: ……… MOVE the limbs to assess the range of motion. Active movement is observed first, then passive

Determine the power of the muscles responsible for each movement of a joint according to the *Medical Research Council grading* ***Power***:…………….

The ligament to look for abnormal movements ***Stressing:*** ………

Examine the sensation and reflexes of the effected part

Distal Pulse:……… Assess peripheral circulation

Special test:………. Apply the special tests according to the required condition

Laboratory: :……… investigations

Imaging techniques:…Radiographs are useful, but leave them until last

N.B: Examine painful area last

2. Common types of emergency and orthopaedic splints:

Spine:

- Splint patients with spinal injuries with a background splint before moving them.

Fig. 1.1

- Use sandbags, rolled towels, or rolled blankets on each side of the head for cervical spine trauma.

Fig. 1.2

- Cervical collar.

Fig. 1.3

- Spinal Jacket.

Fig. 1.4

Upper Extremity Splinting:

Figure of -8- splint.

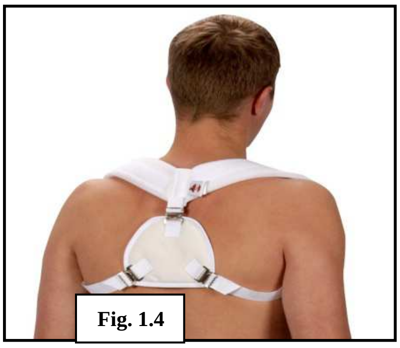


Fig. 1.4

Cramer splint.

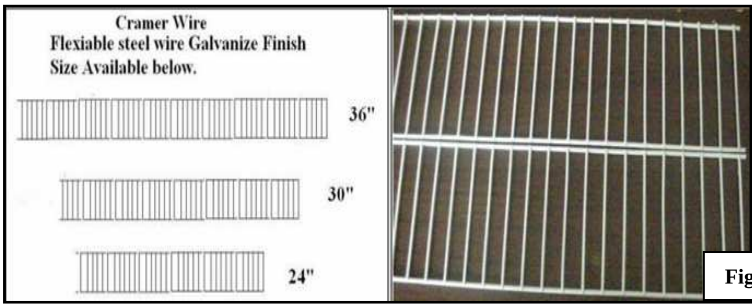


Fig. 1.5

Triangular sling.

Fig. 1.6

Arm sling.

Fig. 1.7

Lower Extremity Splinting:

Thomas's splint.

Fig. 1.8

Cramer splint

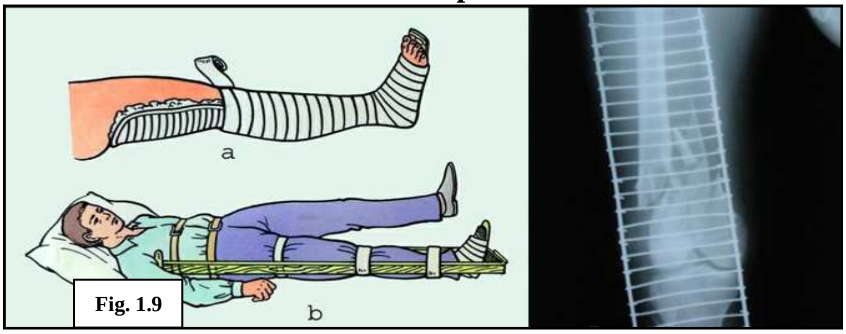


Fig. 1.9

Robert Jones bandage

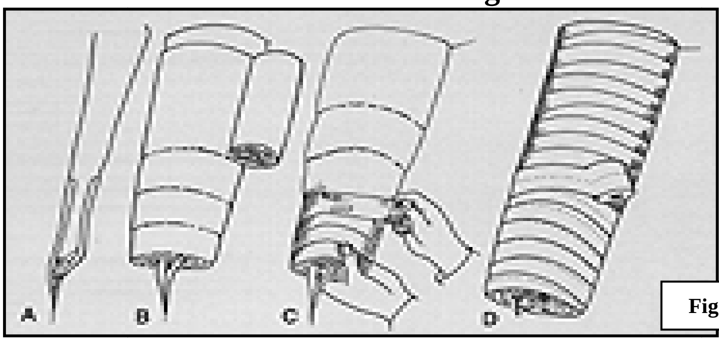


Fig. 1.10

Braun's and Bohler's splints.

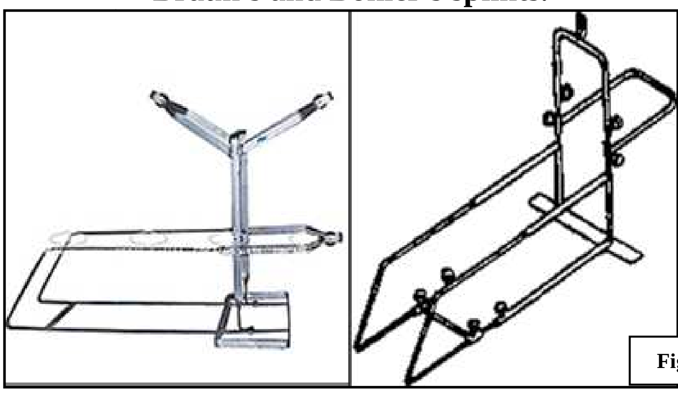


Fig. 1.11

3. Plaster of paris

- Types
- Techniques

4. Skin and Skeletal Tractions

- Types

- Techniques

Skin traction

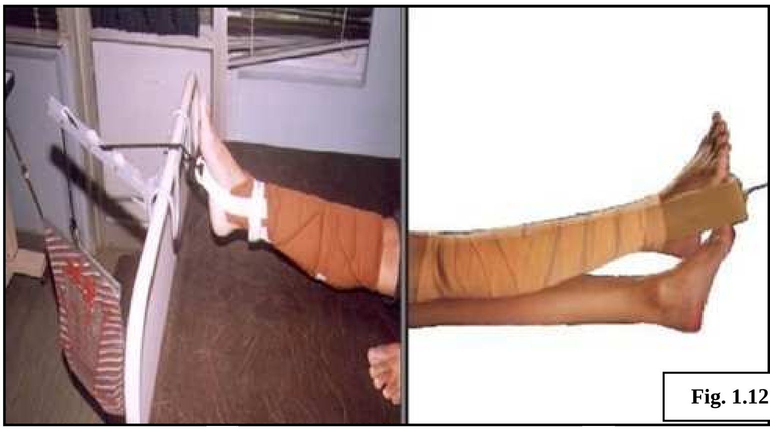


Fig. 1.12

Skeletal traction

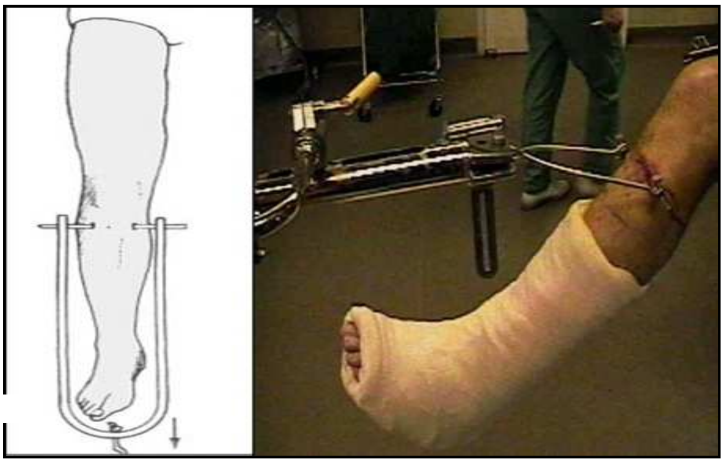


Fig. 1.13

5. **Joint motion measurement and muscle strength grading.**
    - Reflexes of the upper and lower limbs
    - Dermatomol sensory distribution in the upper and lower limbs.
6. **Cervical spine examination.**
    - Routine examination
    - Adson's test
    - Wright test
    - Roos test
7. **Shoulder Examination**
    - Routine clinical examination
    - Apprehension test
    - Drop arm test
    - Sensory examination of the axillary nerve.
8. **Elbow examination**
    - Routine clinical examination
    - Carrying angle
    - Tennis elbow test.
9. **Examination of the wrist and hand**
    - Routine clinical examination
    - Palpation of the Radial and ulnar artery
    - Allen test
    - Sensory examination of the hand median, ulnar and radial nerves
    - Motor examination of the median, ulnar and radial nerves
    - Radial nerve.
        - Drop hand
    - Median nerve
        - Benediction test (pointing index test).
    - Ulnar nerve
        - Froment's test
        - Card test

10. **examination of the hip and pelvis**
    - routin clincal examination
    - barlow's test
    - Ortolani's test
    - Trendeleburg's test
    - Shenton's lines
    - Pirken's lines
    - Bryant's triangle
    - Nelaton's line
    - Schoemacker's lines
    - Where to palpate the femoral artery and vein
    - Thomas's test.

11. **Clinical examination of the knee**
    - Routine clinical examination
    - Where to palpate the popliteal artery

- How to detect rupture of the extensor apparatus o the knee
- Test for effusion of the knee.
  1. Cross-fluctuation test
  2. the patellar tap
  3. the bulge test
  4. the patellar hollow test
- anterior drawer test
- posterior drawer test
- Mc Murray test
- Patellar apprehension test.

12. The ankle and foot

- Routine clinical examination
- Palpation of the posterior tibialis artery
- Palpation of the pedis dorsalis artery

13. The spine

- Routine clinical examination.
- Straight leg raising test.
- Scoliosis fixed and mobile.
- Coin test.
- Sciatic nerve injury.
  - Drop foot.

History taking

Personal Identification:

- Identify the patient's name, age, sex, occupation, address, marital status and religion.

Chief Complaints:

- Determine the exact patient's complains for which he seeks medical advice.

History of present Illness:

- Trace the symptoms (injury, pain, stiffness swelling, deformity, instability, weakness, altered sensibility and loss of function) step by step from their earliest beginning up to the time of the consultation.
- Record the patient's own view on the cause of the symptoms.
- Know the mode of onset.
- Describe the activities that improve the symptoms or to make them worst.
- Know the effect of any previous treatment to the present condition.
- Symptoms in other parts of the body and whether the general health is affected.
- Determine why the patient decided to seek advice.
- To what extent the patient is worried by his disability.

Past History:

- Find any previous childhood disorders.
- Find any previous periods of incapacity.
- Find any history of an old injury.
- Find any previous systemic disease.
- Identify any previous medication.
- Obtain a history on alcohol and drug abuse.

Family History:

- Muscloskeletal disorders in the patient's family.

Social Background:

- Details about work, travel, recreation, home circumstances and the level of support by family and friends.

Clinical Examination

Examination at the moment we set eyes on the patient:

- Detect any unusual appearance.
- Detect any unusual posture.
- Observe any change in the normal elements of the gait cycle.
- General attitude.

Examination of the part complained of:

- Realize the importance that the patient should be suitably undressed.
- Compare the affected limb to the sound one.
- Realize the importance of proceeding in a purposeful, comprehensive discipline ***(LOOK, FEEL, MOVE, MEASURE and TEST).***

A. LOOK:

- Observe any change in the color, texture and integrity of the skin. Look for redness, cyanosis pigmentation, shininess, loss of hair abnormal creases vascular collaterals scars or sinuses, etc.
- Observe any change in the contour of the soft tissue (look for swelling wasting of muscles or a definite lump)
- Observe the general alignment of the bones and position of the joints to detect any deformity shortening or unusual posture.
- Determine the causes of a joint deformity.
- Determine the causes of a bone deformity.
- Determine the observable characteristics of a swelling or lump.

B. FEEL:

- Feel the skin for temperature, humidity, sensation and tenderness.
- Feel the soft tissue for a lump, tonicity, pulsation and tenderness.
- Feel the bones and joints for any change in the outlines, thickening of bone, synovium, excessive fluid and tenderness.
- Determine the palpable characteristics of swelling or lump.

C. MOVE :

- Check the range of active movements at their common planes.
- Compare the active range to the passive range of movement.
- Check the joint stability and exclude any abnormal mobility.
- Determine the causes of joint stiffness (fixed joint or limited movement).
- Determine the causes of joint laxity.

D. MEASURE

- Measure the length of the lower limbs in case of true discrepancy in length.
- Measure the length of lower limbs in case of an apparent discrepancy in length.

E. TESTS of FUNCTION

- Apply the special tests on the patient as their condition required for example: Trendelenburg test, straight leg raising test (SLRT), Bragard's test, Dogas test.
  Apprehension test for dislocatable joints, ortolani's test, Barlow's test. Thomas's test, Mc Murray's test, Drawer test, Apply test, Lachmann's test. Patellar tap and fluctuation test, stress tests at the knee and ankle joints, and tests of nerve injuries. Test for cervical spine, back and upper limbs disorders

F. EXAMINATION of PERIPHERAL CIRCULATION

- Assess the state of circulation (look, feel, move and measure).
- Remind the five P's

G. NEUROLOGICAL EXAMINATION

- Find any changes in the appearance of the limb or part of it (clawhand, drop wrist, drop foot, a flail lower limb, etc.)
- Determine the power of the muscles responsible for each movement of a joint according to the ***Medical Research Council grading***
- Test the tendon, superficial and plantar reflexes
- Test for sensibility (touch, pinprick, Tinnel's sign, temperature recognition, two-point discrimination, vibration, and position sense, sense of joint posture, stereognosis and sense of balance.

Examination of possible sources of referred symptoms

- Find through the clinical examination, any abnormal finding in the body parts in vicinity to the part complained of, particularly if the source of symptoms is still in doubt.

General examination of the body as a whole

- Realize the importance of the general examination of the whole body.
- Assess the general physical condition.
- Assess the psychological outlook.

Diagnosis imaging

Radiographic examination

- Identify the x-ray film
- Examine methodically the X-ray film according to a standard routine
- Interprete the radiographic findings.

Special Radiographic Techniques

- Find out x-rays using contrast media (sinography, arthrography, myelography and radiography).
- Identify tomography
- identify computed tomography (CT)
- Identify magnetic resonance imaging (MRI)
- Identify diagnostic ultrasound.
- Identify radionuclide imaging.
-

Methodological Identification and interpretation of Radiographs in Orthopeadics

1. GENERAL APPROACH :

Identify the patient

- Name
- Age
- Sex
- Date

Identify the film generally

- Which film?
- Which view?
- Which quality?
    - contrast well the soft tissue and bony tissue
    - include one joint above and one joint below
    - compare one side to the other
- Which site?
- Which side?

Identify the local findings

Soft tissue

- shadow of subcutaneous layer
- Shadow of muscular layer.
- Shadow of soft tissue swelling

2. BONE

- **Cortex**
    - continuity
    - regularity
    - density (sclerosis, rarefaction, osteoporosis and osteolysis)
- **Medulla:**
    - Continuity
    - Regularity
    - Density (sclerosis, rarefaction, osteoporosis and osteolysis)

3. JOINTS

- **Articular space**
    - wide
    - narrow
    - obliterated
    - Unilateral
    - Bilateral
- **Articular Surface**
    - Normal contact
    - Partial lose of contact (subluxations)
    - complete lose of contact (dislocation)
- **Articular margin**
    - regular
    - Irregular
    - Bony prominence “osteophyte”
- **Subchondral bone**
    - cysts
    - Rarefaction
    - Sclerosis

Radiographs of the vertebral column

1. Numerating the vertebrae
    - Descending method.
    - Ascending method
2. change in normal curvatures
    - kyphosis
    - Scoliosis
    - Flat (straight)
3. The height of the vertebrae.
4. The width of the vertebrae.
5. The height of the inter-vertebral space
6. The relation of the vertebra to the one below and one above.
7. The eyes of the vertebra (the base of each attached pedicle to the vertebral body).
8. The nose of the vertebra (the spinous process).
9. The ear of the vertebra (the transverse process).
10. The distance between the pedicles.

Follow the rule of two on reading the X-Ray:

1. At least two views
2. Two sides
3. Two joints one below and one above
4. Two occasions
5. Avoid two extreme distances from the X-Ray.
6. Two Brains (discuss with your colleagues Radiologist, pathologist…)

2.

Chapter 2
General Examination

Routine for clinical examination:

Listen to what the patient tells you:

***Inspection*:…………** LOOK — Gait, Posture, Attitude — at the area — Skin, Soft tissue, Bone

Palpation:………… FEEL gently for swelling, painful area, temperature changes and Tenderness (skin, soft tissue, bone).

Measure:………… limb length and girth.

***Movement*: ………** MOVE the limbs to assess the range of motion. Active movement is observed first, then passive.

***Power*:…………….** Determine the power of the muscles responsible for each movement of a joint according to the *(Medical Research Council grading*).

***Stressing:* ………** The ligament to look for abnormal movements.

***Sensation*:**
Reflexes: Examine the sensation and reflexes of the effected part.

***Distal Pulse*:………** Assess peripheral circulation.

***Special test*:……….** Apply the special tests according to the required condition .

***Laboratory:* :………** investigations.

Imaging techniques:…Radiographs are useful, but leave them until last.

N.B: Examine painful area last.

Equipment requirements

1- A tape measure (preferably) of the type used by tailors) , for measuring such things as limb lengths and girths (For evidence of lnequality in lengths or evidence of muscle wasting) , and sometime for assessing movement (e.g. in the spine, knee and rib cage).

Fig. 2.1

2- A goniometer , preferably with an easily read scale with reciprocals , for measuring the range of movements in a joint.

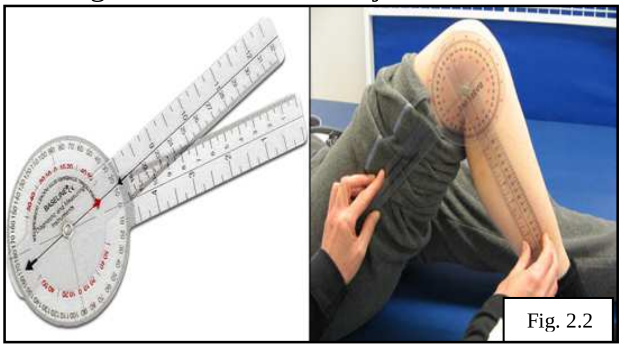


Fig. 2.2

3- A Tendon hammer , for eliciting limb reflexes.

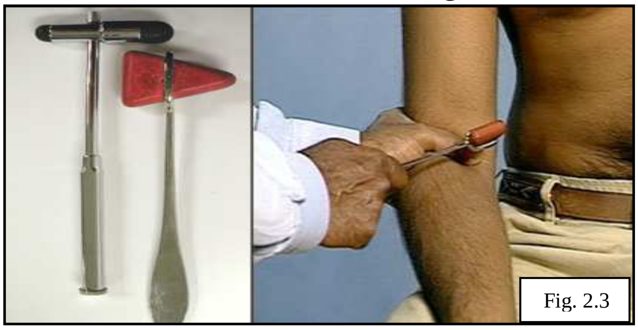


Fig. 2.3

4- A Needle , for assessing disturbance of Sensation to pin – prick . for each new case ,a fresh , sterile (hypodermic) needle should always be employed.

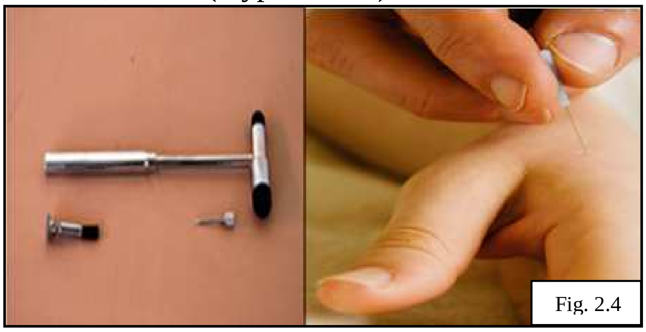


Fig. 2.4

5- Hand torch.


Fig. 2.5

Gait: *"The sequences of movements that making the walking cycle"* .

The gait cycle (The Sequence of events in each step) consists of four parts :
1- Heel strike
2- Stance phase
3- toe off
4- swing phase

Stance Phase	Swing Phase
1. Heel Strike	1. Acceleration
2. Foot Flat	2. Midswing
3. Midstance	3. Deceleration
4. Push-off (Toe-off)	

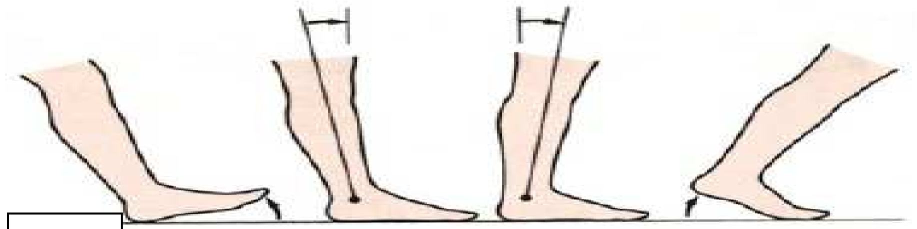
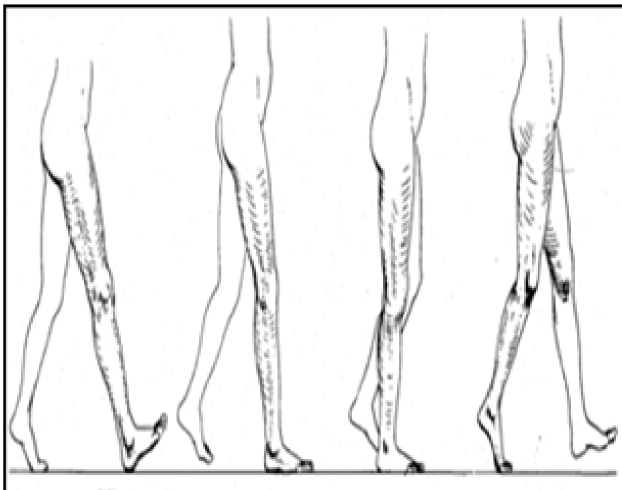


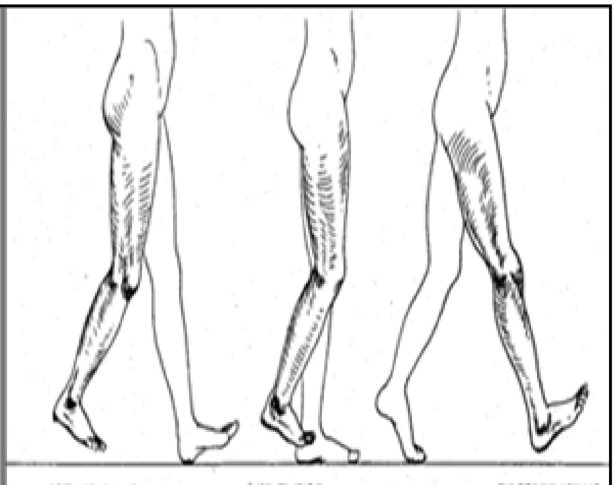
Fig. 2.6

ait – the three rockers of ankle-stance phase
The first rocker begins with heel-strike – if the anterior compartment muscles are weak, a 'foot-slap' is noticeable; or if the ankle is in fixed equinus, this rocker may be absent altogether. In mid-stance, the centre of gravity of the body (and ground reaction force) moves from a position posterior to the ankle joint to anterior (second rocker). The third rocker produces an acceleration force that shifts the fulcrum of the pivot forwards to the metatarsal heads, just prior to toe-off (Gage, 1991).



HEELSTRIKE FOOT FLAT MIDSTANCE PUSH OFF

Fig. 2.7 The phases of gait. Stance phase: (a) heel strike, (b) foot flat, (c) midstance, and (d) push-off.



ACCELERATION MIDSWING DECELERATION

The phases of gait. Swing phase: (a) acceleration, (b) midswing, and (c) deceleration.

Fig. 2.8

Many different gaits are Seen , but the following are probably the most common.

<u>1- Antalgic hip gait:</u>

The patient leans his body over the side of the painful hip while weight bearing in order to reduce the load on the hip and takes a short stride to minimize the times that painful limb bears weight. The commonest cause is osteoarthritis .

2- Scissor gait of cerebral palsy:
In true Scissor gait , adductor spasm makes the legs cross over one another , but in less severely affected patients the thighs are internally rotated and held firmly together.

3- Drop foot gait:
If the ankle dorsiflexors are weak because of common peroneal nerve palsy or a lumbar root lesion , the patient lifts the knee unusually high and puts the foot down to the ground first to produce a high stepping gait that is easily recognize

4- Hemiplegic gait:
The abnormal gait of hemiplegia is caused by flexors spasm on the effected side . The upper limb is usually affected as well and the abnormal posture and gait are easily identified.

5- Trendelenburg gait:
If the hip is unstable or the abductors power inadequate, the Trendelenburg sign will be positive on every step and the pelvis will tilt downwords on weight bearing to produce a dipping or rolling gait.

Painful foot gait:
Patients with feet that hurt on weight – bearing walk with a typical shuffling gait to minimize sudden increase in load on the foot . This gait can be caused by simple problem such as blister or stone in the shoe.

Other abnormal gait result from weakness of the tibialis anterior, rupture of the tendon Achilles and choreoathetosis.

A-Inspection:

1- Ensure appropriate conditions
I- patient resting on firm couch
II- whole of limb , opposite limb, and spine exposed.
III- surroundings should be
a- warm
b- well-lit
c- Relatively Quiet

2- Skin
I- Colour
a- Erythema ,cyanosis , pallor , venous flare.
b- pigmentation or tattooing.
II-Texture – normal shinny , ect. -
III- Trophic changes → Loss of hair.
→ Trophic ulcer .
IV-Scars.
V- Sinuses .

3- Subcutaneous tissues shape, contours , swellings, size
a- fat and Lipomata
b- Synovium
c- Cysts
d- Effusions
e- Muscle and tendon (wasting and Fasciculation)
f- Swellings of vessels and nerves

4- Skeleton – shape , contours , swellings, size .
- Lumps and excrescences
- Mal-alignment or mal-rotation .
- Deformity or limb asymmetry.

B-Palpation

1- Skin
a- Temperature
b- Sweating – moist or dry
c- Laxity
d- Sensation – on MRC scale grading:

S_0- Absent sensation in area exclusively supplied by the effected nerve .
S_1- Recovery of deep cutaneous pain /pain perception only
S_2- Return of some superficial cutaneous pain and tactile sensibility /pain and some touch /
S_3 - Return of some superfacial cutaneous pain and tactile sensibility, but without over reaction ./ pain and touch with no overreaction /
S_{3+} - Return of two point discrimination .
S_4 – Normal Sensation.

2- Subcutaneous tissues

I- lump - collapsible , fluctuant or hard .

a- Size
b- Site
c- Margin
d- consistency
e- Tenderness .
f- Multiplicity
g- Fixed or mobile
h- pulstile or not

II- Effusion

a- Immediately evident
b- Elicits by fluid shift

III- Muscle tone and contractility

Tone in individual Muscle groups is tested by Moving the Nearby joint to stretch the muscle .

a- Increased tone (Spasticity) is characteristic of upper Motor neuron disorder such as cerebral palsy and stroke. It must not be confused with rigidity (the lead – pipe) or cogwheel effect)which is seen in parkinson's disease.
- Decreased tone (Flaccidity) is found in lower motor neuron lesions , for example , poliomyelitis)
It is important to recognize that a spastic muscle may still be weak.

IV-Tenderness

a- localized
b- Diffuse

3- Skeleton (bone)

a- contour, shape, size.
b-Relationship of bony landmarks
c-Tenderness

C- Measurement

-Limb

I- Girths (Compare to contralateral side)
II- Length
a- Real
b- Apparent
- Real shortening , in which there is loss of bone length , must not be confused with apparent loss due to a deformity at the hip , in which there is no loss of bone length.
- True length is measured from the anterior superior iliac spine to the medial malleolus and apparent length from a midline structure , such as the pubic symphysis or xiphisternum to the medial Malleolus . The patients must be lying as straight as possible when these Measurements are made.

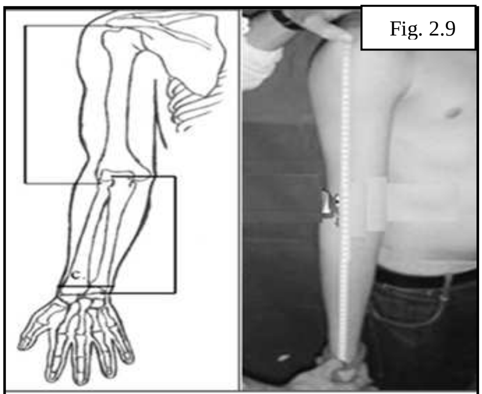
Fixing the tape- Measure at the anterior superior iliac spine :-
A flat metal end is placed immediately distal to anterior superior iliac spine and is pushed up against it . The thumb is then pushed Firmly backwards against the bone, and the tape-end together . This gives rigid fixation of the tape- measure against the bone.

Taking the reading at the medial malleolus

The tip of the index finger is placed immediately distal to the medial malleolus and pushed up against it . The thumb nail is brought down against the tip of the index finger so that the tape – measure is pinched between them . The point of measurement indicated by the thumb nail (figure 17)

For the upper limb the measurement should be taken from the acromeal process to the tip of the Radial styloid process while the limb in anatomical position. (figure 18).

Fig. 2.9



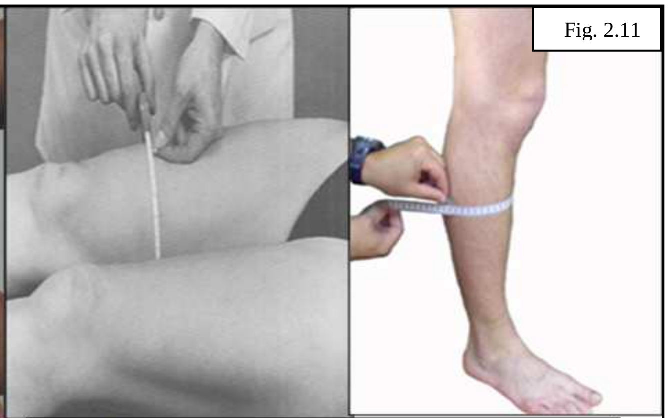
Upper limb measurement

- measurement of the girth of the limb should be at fixed point for example to the upper limb at the midline between the acromeal process and the lateral epicondyle, for the lower limbs at 18 cm above the knee joint line for quadriceps muscles wasting or 14 cm distal to the knee joint for culf muscles.

Fig. 2.10

Girth measurement of upper limb

Fig. 2.11



Girth measurement of lower limb

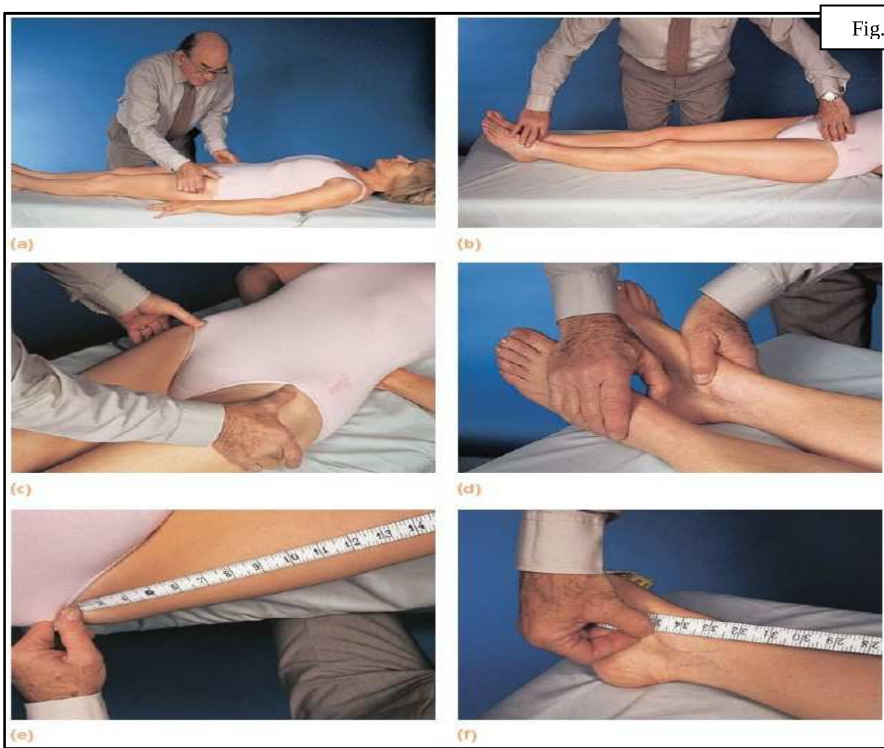


Fig. 2.12

Measurement Make sure the patient is lying straight on the examination couch and that the pelvis is absolutely level – the anterior superior iliac spines at the same level in relation to the longitudinal axis of the body (c). Then check the medial malleoli (d); discrepancy in leg length will usually be obvious. (e,f) Leg length is most accurately assessed by measuring from the anterior superior iliac spine to the tip of the medial malleolus on each side.

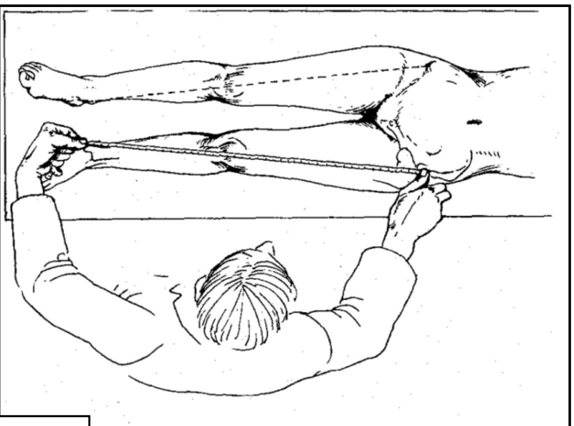


Fig. 2.13 Measure from one fixed bony point to another to find true leg length.

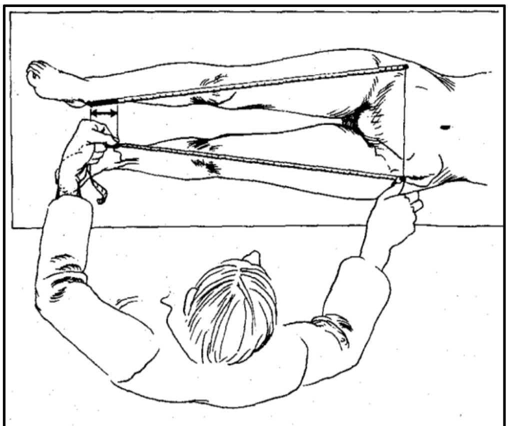


Fig. 2.14 rue leg length discrepancy.

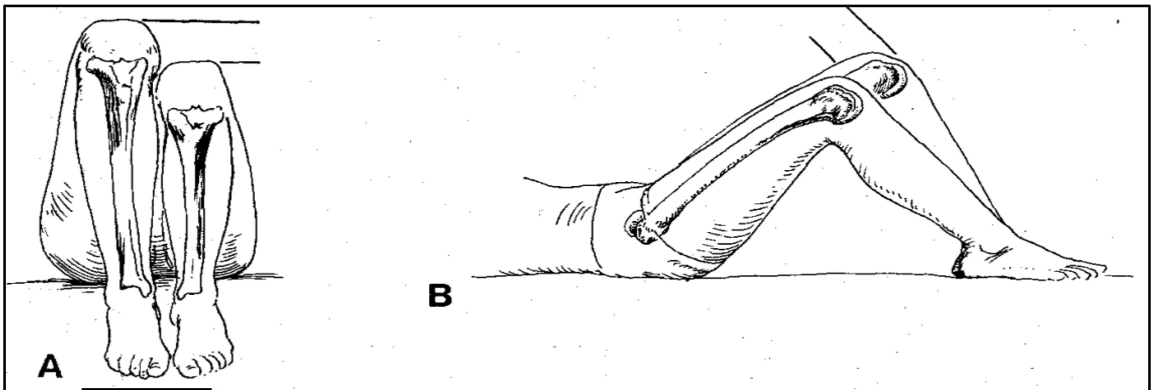


Fig. 2.15 **A.** Tibial length discrepancy. **B.** Femoral length discrepancy.

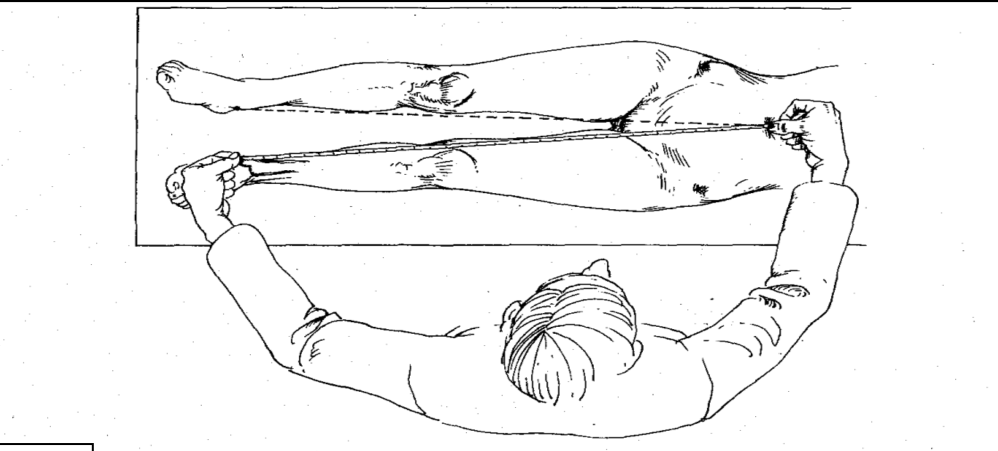


Fig. 2.16 Measure from a nonfixed point to a fixed point to determine an apparent leg length discrepancy.

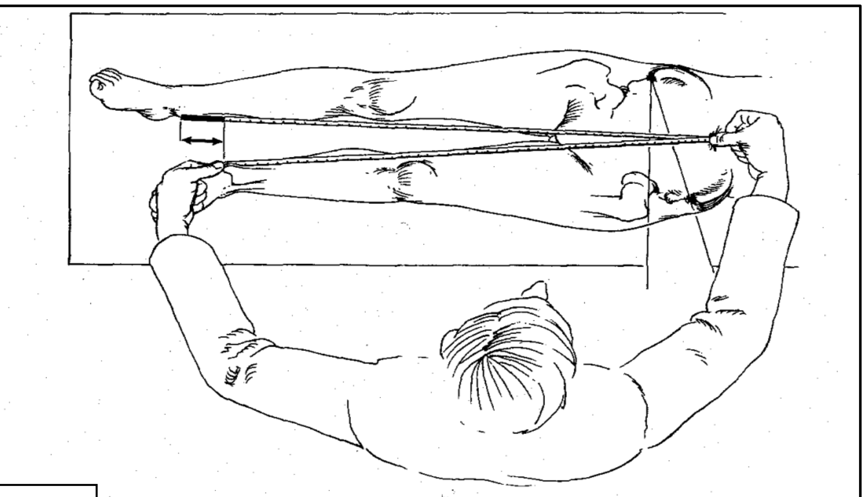


Fig. 2.17 An apparent leg length discrepancy associated with pelvic obliquity.

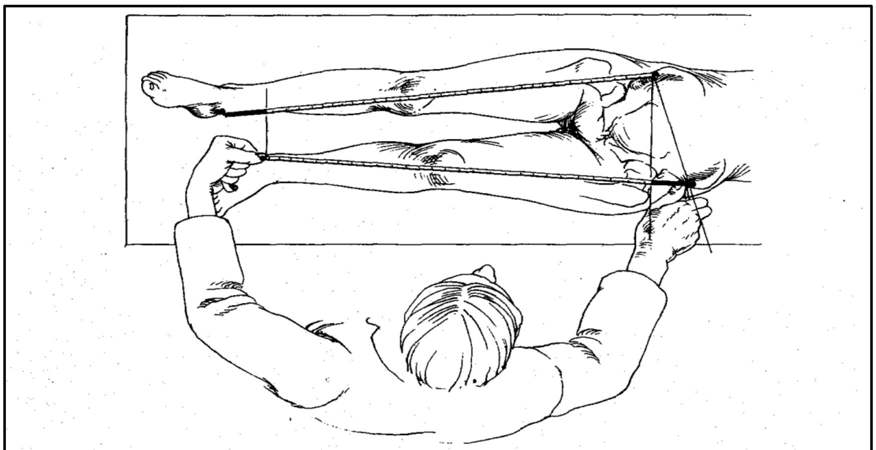


Fig. 2.18 True leg length measurements are equal despite the apparent leg length dis-.

D- Movement:

a- Passive – by the examiner
b- active – by the patient himself
c- producing pain or spasm
d- Accompanied by crepitus

Joint crepitus is usually coarse and fairly diffuse tendon crepitus is fine and precisely localized to the affected tendon sheath.

E- Muscle power: *"the strength of muscle enough to move the joint"*
It is usually graded on the medical Research council scale (MRC):

Grade 0 – No Movement
Grade 1- only a flicker Movement
Grade 2- Movement with gravity elimination
Grade 3- Movement against gravity.
Grade 4- Movement against resistance.
Grade 5- Normal power

It is important to recognize that muscle weakness may be due to muscle disease rather than nerve disease. In muscle disorders the weakness is usually symmetrical and sensation is intact .

Fig. 2.19

Knee extension against resistance | Knee flexion against resistance

Fig. 2.20

Ankle plantar flexion against resistance | Ankle dorsiflexion against resistance

Fig. 2.21

Big toe extension against resistance.

F- Reflexes of the upper and lower limbs

Upper limb reflexes

The three basic reflexes which evaluate the integrity of the nerve supply to the elbow are :

1- The biceps reflex. C_5
2- The brachioradialis reflex.C_6
3- The Triceps reflex.C_7

Each of these is a deep tendon reflex a lower motor neuron reflex., transmitted to the cord as far as the interior horn cell and returning to the muscle via the peripheral nerves.

- Biceps reflex. – C_5

Although the biceps is innervated by the musculocutaneus nerve at neurologic levels C_5 and C_6 , its reflex action is Largley a function of C_5 . Thus , in testing the biceps reflex, you are primarily assessing the integrity of neurologic level C5.
To test the reflex , place the patient's arm over your opposite arm , so that it rests upon your forearm with your hand supporting the patient's arm under the elbow's medial side , place your thumb on the tendon of the biceps in the cubital fossa if the patient Flexes his elbow slightly you will feel the tendon stand out under your thumb.
Have the patient rest his arm on your forearm – and let it relax completely . when his arm is totally relaxed. Top your thumbnail with the narrow end of a reflex hammer . ***the biceps should jerk slightly. You will able either to see on to feel its movement.***

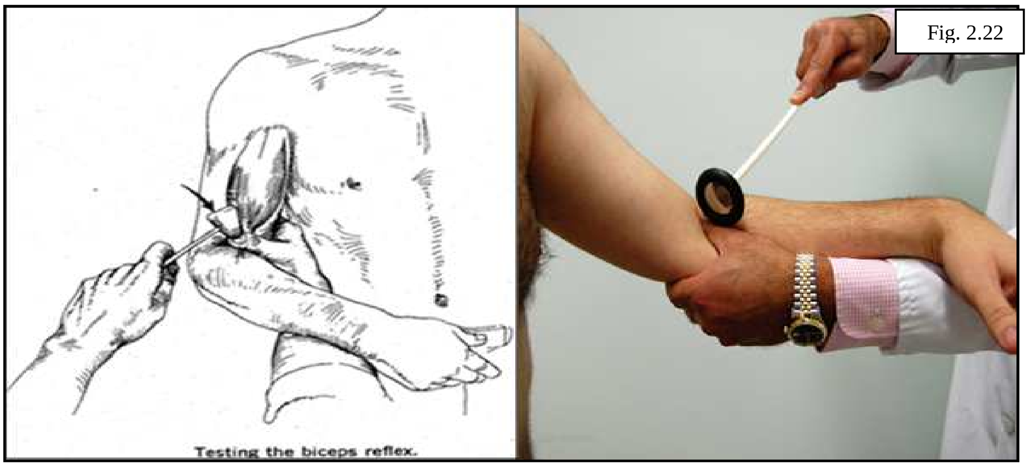


Fig. 2.22

- Brachioradialis reflexes – C_6

The Brachioradialis muscle is innervated by the radial nerve via the C_5 and C_6 neurologic level , but its reflex is largely a function of C_6 .
To test the reflex , support the patient's arm the same manner used to elicit the biceps reflex .
Using the flat edge of the reflex hammer , tap brachioradialis tendon at the distal end of the radius to elicit a radial jerk. Then , test the opposite arm and compare and record the result.

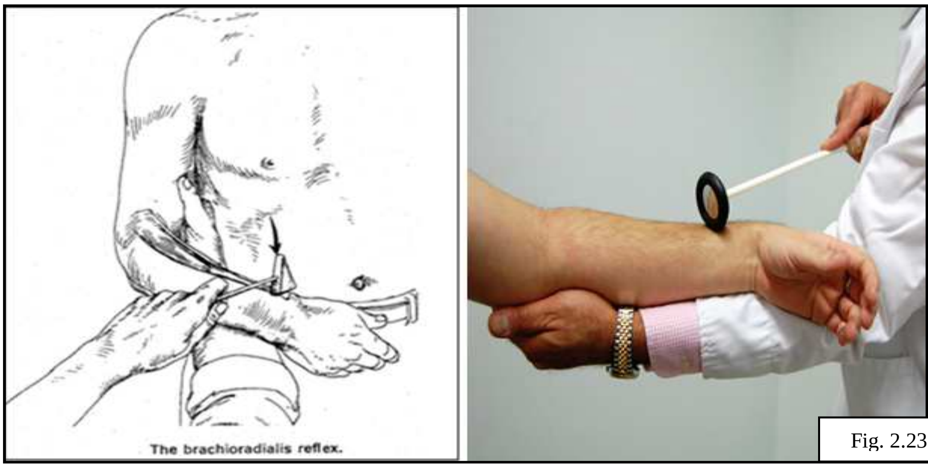


Fig. 2.23

- Triceps Reflex – C_7

The triceps is innervated by the radial nerve .

The reflex is largely a function of the C_7 neurologic level .

Keep the patient's arm in the same position used for the two previous testes . Ask him to relax his arm completely . When you are certain it is relaxed (you can feel the lack of tension in the triceps muscle), tap the triceps tendon where it crosses the olecranon fossa with the narrow end of the reflex hammer .You should be able to see the reflex or to feel it as a slight jerk on your supportive forearm.

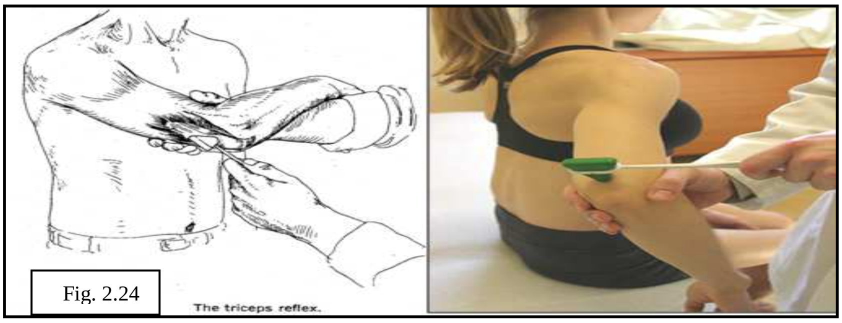


Fig. 2.24

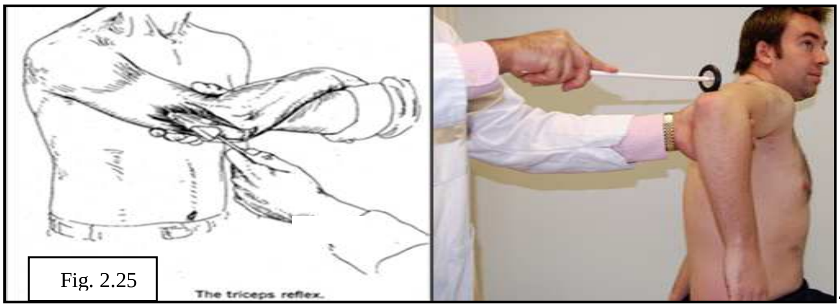


Fig. 2.25

***Dermentomal sensory distribution of the upper limb*.**

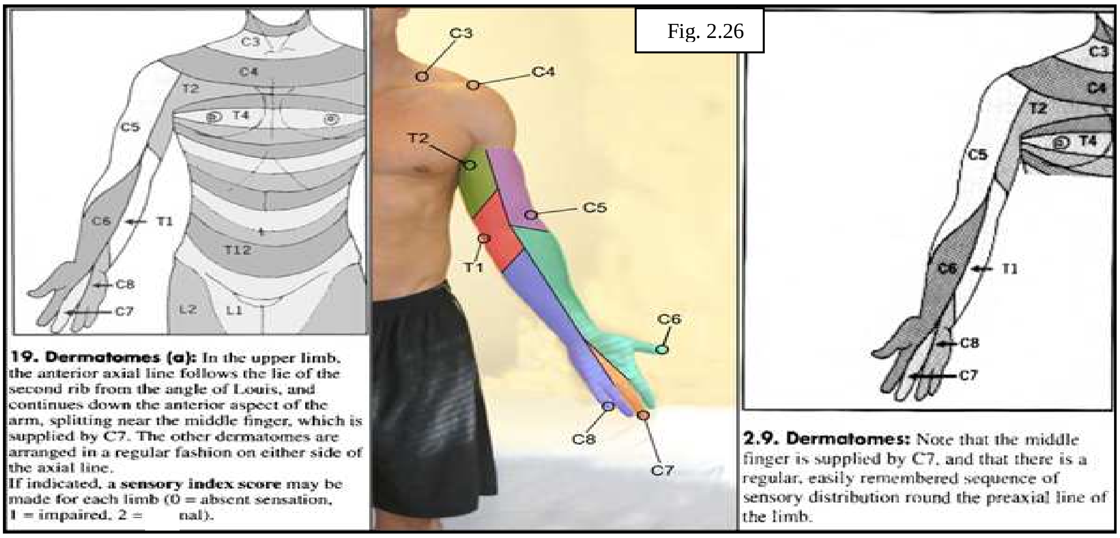


Fig. 2.26

- Reflex of the lower limb:

- **Patellar Reflexes:** $L_{2,3,4}$ – mainly L_4 the patellar reflex, or knee jerk , is a deep tendon reflex , mediated though nerves emanating from the $L_{2,3,}$ **and** $_4$ neurologic levels ,but predominantly from L_4 . for clinical application , the patellar reflex is to be considered an L_4 reflex . However , even if the L_4 nerve root is pathologically involved , the reflex may still be present, since it is innervated by more than one neurologic level .

- *To test this reflex , have your patient sit on the edge of the examination table with his legs dangling free, or have him sit on chair with one leg crossed over his knee . If he is bed patient , support his knee in a few degrees of flexion. In these positions , the infrapatellar tendon is stretched and primed . Then , to locate the tendon accurately , palpate the soft tissue depression on either Side of the infrapatellar tendon .Elicit the reflex by tapping the tendon with neurologic hammer at the level of the knee Joint , using a short , smart wrist action . This procedure should be repeated on the opposite leg , and the reflexes graded as normal , increased , decreased , or absent.*

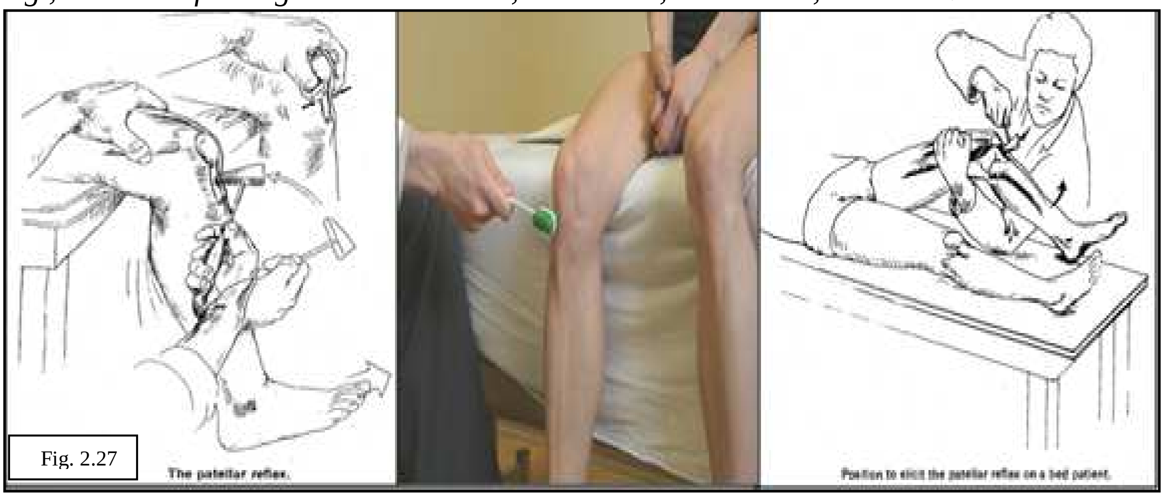


Fig. 2.27

Achillis tendon reflex – S_1

Achillis tendon reflex is a deep tendon reflex , mediated though the gastronemius – soleus muscles .

It is supplied predominantly by nerves emanating from the S_1 cord level . If the S_1 root is cut or compressed, the achilles tendon reflex is virtually absent.

To test the achillis tendon reflex , ask the patient to sit on the edqe of the examining table with his legs dangling , and put the tendon into slight stretch by gently dorsiflexing the foot. Then locate the tendon accurately , place your thumb and fingers into the soft tissue depression on either side of it . tap the tendon with the flat end of neurologic hammer using a wrist- flexing action to induce sudden , involuntary planter flexion of the foot.

If the patient is bedridden , cross his leg over his opposite knee so that the ankle joint is free
If the patient is lying prone in bed , ask him to flex his knee to 90º and prime the tendon by slightly dorsiflexing the foot . then strike the achillis tendon.

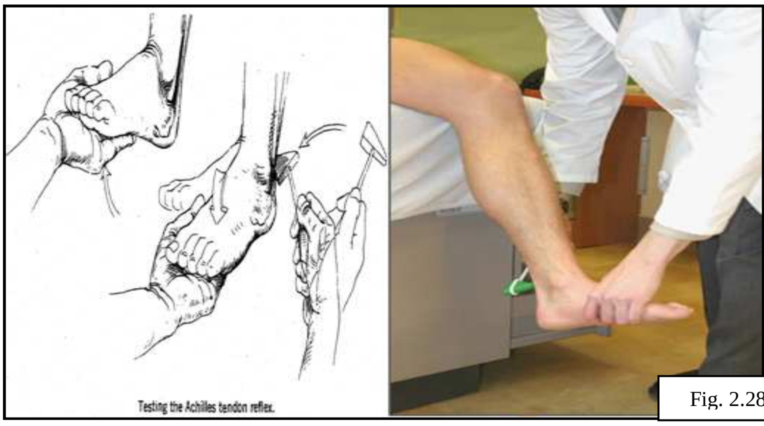


Fig. 2.28

<u>Dermentomal sensory distribution on the lower limb</u>.

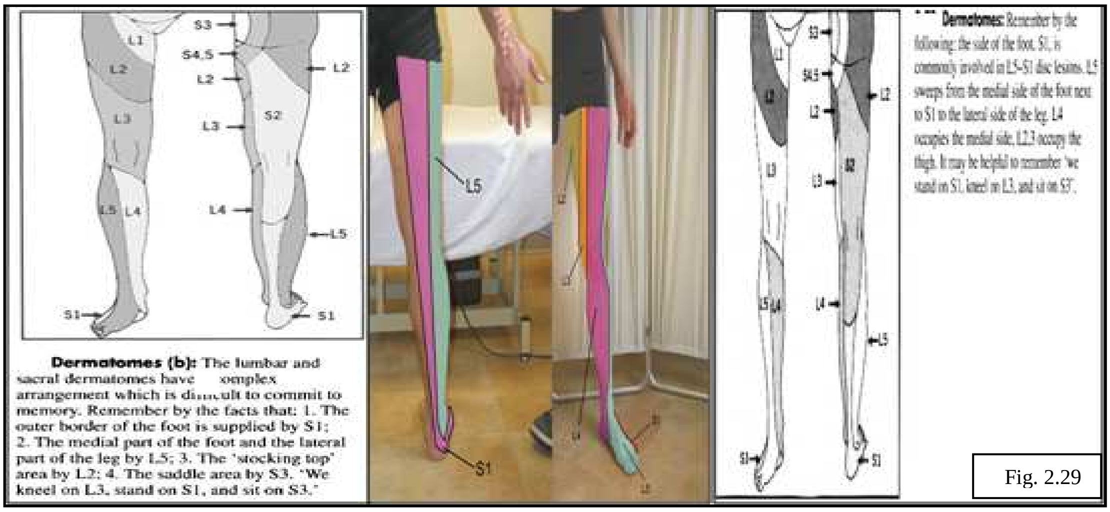


Fig. 2.29

<u>Peripheral circulation</u>
<u>Distal pulse</u>

<u>Upper limb</u>

1- ***<u>Axillary pulse</u>***
- Abduct the shoulder.

- Rest the hand against iliac crest.
- Palpate the pulse posterior to the anterior fold of the axillary fossa (the pectoralis muscle) against the humerus.

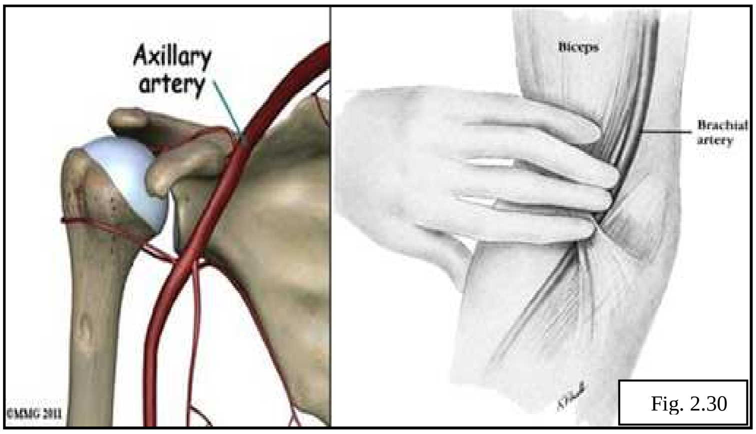


Fig. 2.30

2- ***Brachial artery***

- Flex the elbow against resistance.
- Palpate the biceps tendon at the anterior aspect of the elbow.
- Relax the elbow.
- Palpate the brachial artery medial to the biceps tendon.

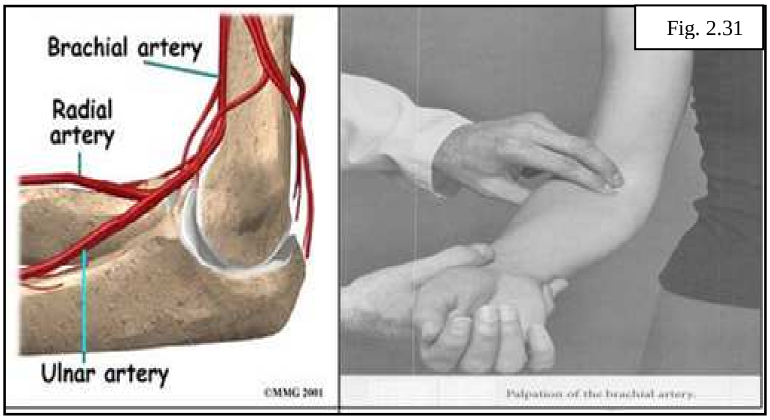


Fig. 2.31

3- Radial artery

- Flex the wrist against resistance.
- Palpate the most superficial tendon at the wrist – the Palmaris longus.
- Lateral to the Palmaris longus palpate the flexor carpi radialis tendon.
- Lateral to the flexor carpi radialis tendon on the anterior aspect of the styloid process palpate the radial pulse.

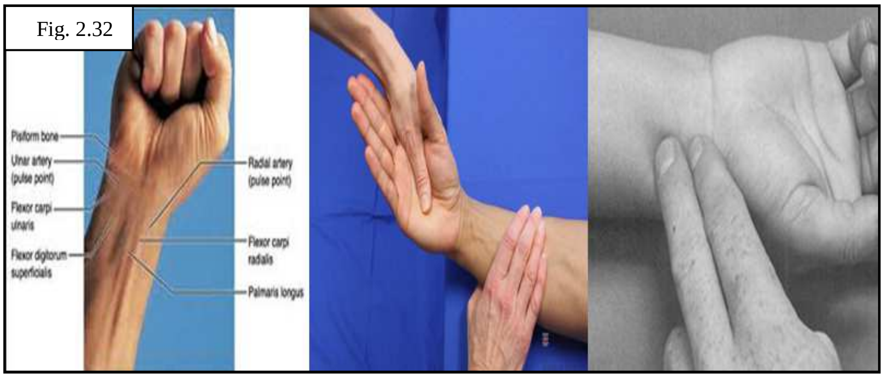


Fig. 2.32

4- ***Ulnar pulse***

The pulse of ulnar artery is palpable proximal to the pisiform bone just before the artery crosses the wrist on the anterior aspect of ulna, when press the artery against the ulna.

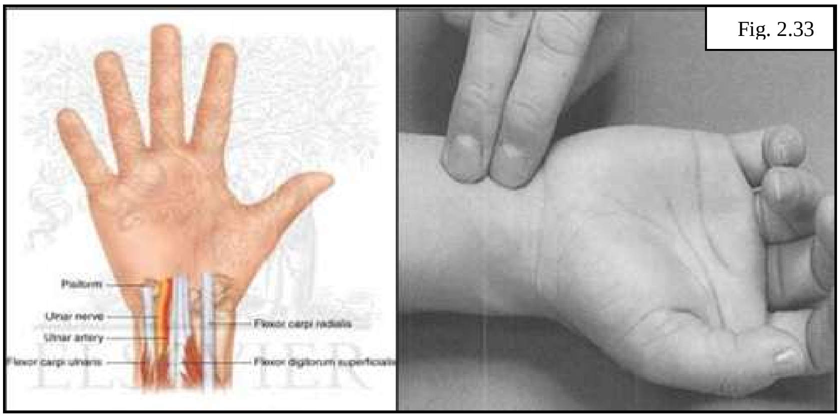


Fig. 2.33

Lower limb

5- ***Femoral artery***

- Patient lying on supine position.
- The hip in rest position (mild abduction and external rotation and flexion).
- The mid of the inguinal ligament (midway between anterior superior iliac spine & pubic tubersity).
- Just 2cm below the inguinal ligament.
- Press the femoral artery against the head of the femur.

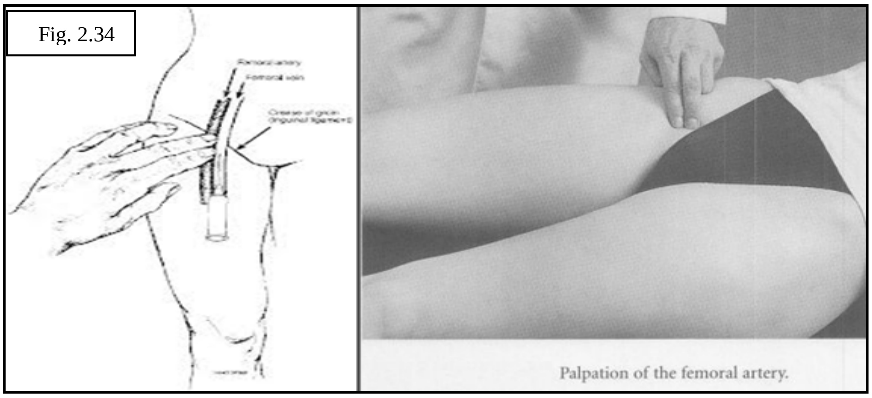


Fig. 2.34

Palpation of the femoral artery.

6- Popliteal pulse

In order to palpate the popliteal pulse , patient should be lie on his face with the knee flexed.

The popliteal artery is felt deep in the middle of the popliteal fossa.

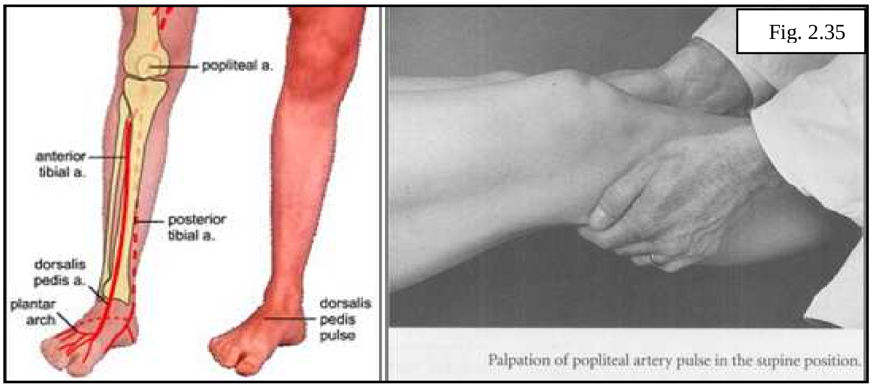


Fig. 2.35

Palpation of popliteal artery pulse in the supine position.

7- Anterior tibial artery:

- Palpate the anterior tibial artery.
- At the lower end of the tibia.
- At the front of the ankle joint.
- Midway between the malleoli.
- Lateral to the tibialis anterior tendon and Extensor hallucis longus.

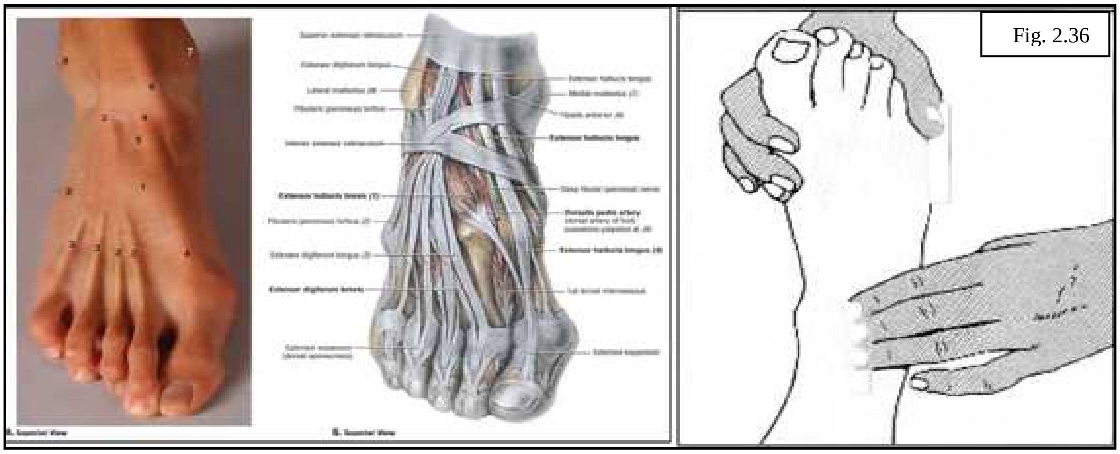


Fig. 2.36

8- *Posterior tibial pulse*

- Midway between the posterior border of the medial malleolus and the medial border of the achillis tendon.
- Press the posterior tibialis artery against the tibia.

Fig. 2.37

9- *Dorsalis pedis pulse*

The dorsalis pedis artery lies between the extensor hallucis longus & the extensor digiterium longus tendon on the dorsum of the foot.

It is abscent approximately in 12 to 15 percent of the time.

- Palpate at the most proximal bony prominence of the interosseus space on first and second cuniform bons.
- Lateral to the extensor hallucis longus.

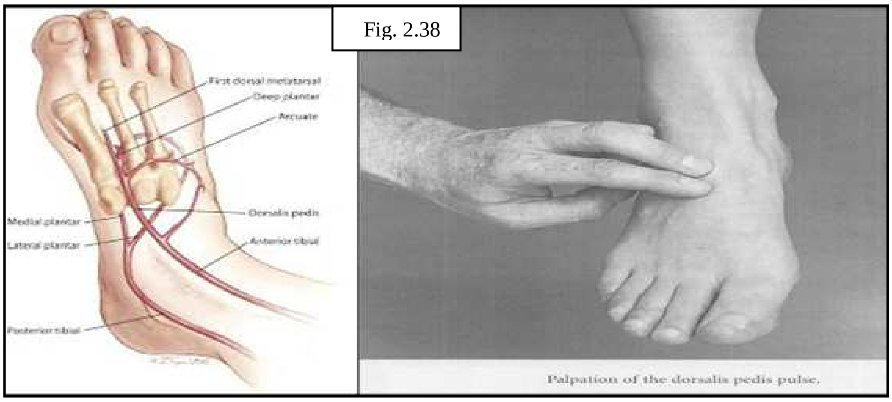


Fig. 2.38

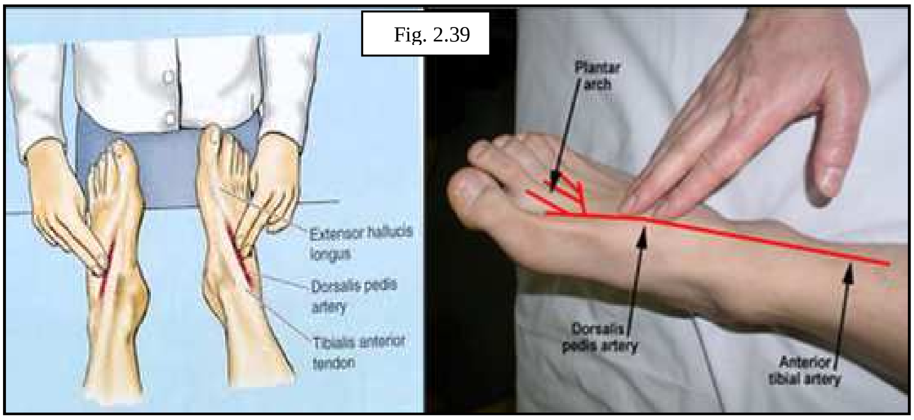


Fig. 2.39

Chapter 3

Diagnostic image

"The map is not the Territory"

Alfred korzybski

Radiographs are essential in orthopaedics, not only to recognize fracture and other bone lesions but also to determine the best way to treat a fracture, accuracy of reduction and the state of union. Radiographs are so important that it is sometimes forgotten that the bones they show belong to patients and it is all too common an error for treatment to be decided on the basis of radiographs alone. Pain and motivation do not show on a radiographs.

They did not show the clinical condition of the patient (in shock ?), the condition of the skin, muscles, tendons, vessels and nerves. They did not show the function of the injured part.

Physics of Radiology:

The visibility of a structure on a radiograph depends upon the atomic weights of its constitute elements.

Calcium with an atomic weight of 40, is easily visible and so are barium (137), and Iodine (12).

Fat, water and carbohydrate, which consist of carbon (12), hydrogen (1) and oxgen (16) are handly visible but the iron (56) of hemoglobin and fascia, which contains sulphur (32) within collagen molecule can be see more clearly.

Careful examination of a radiograph will therefore show far more than just bone.

The individual muscles and the fascial sheaths around them can be seen, and a fluid level of fat in a joint is a sure indication of an intra-articular fracture.

Special techniques:

Tomograms: The x-Ray source and plate are moved to produce a blurred radiograph that leaves only one plane or slice of tissue in focus.

Tomograms are useful in the investigation of defects deep within a bone, but they have their limitation. To make tomographic cuts less than 1 cm apart is difficult and lesions less than 1cm in diameter are easily missed.

Contrast studies:

Radiculography and Myelography: Iodine solutions can be injected into the spinal theca to outline the spinal canal and nerve roots stretched over a prolapsed intervertebral disc.

Arthrograghy: Double-contrast arthrography (the use of two materials, gas and solution opaque to x-rays) can outline the menisci and other intra-articular structures with great clarity.

A radio-opaque medium is injected first, left in the joint long enough to spread over the intra articular structures and the joint inflated gently with gas, usually carbon dioxide, to outline the intra-articular surfaces more clearly.

Discography: Radio-opaque medium can also be injected into the intervertebral discs to demonstrate lesions in the body of the disc. Apart from making the disc lesions visible, the increase of intradiscal pressure caused by an injection may reproduce the patient's symptoms and confirm the diagnosis.

stress radioghraphs: Joints with doubtful stability can be examined under load to detect abnormal joint laxity and are particularly useful at the ankle if plain films are unhelpful.

Comoaterized Tomography (CT scan):
Slight differences between the radio-densities of various elements can be enhanced by computer.
If radiographs are made at different angles and in different planes, the computer can integrate the information to produce pictorial ‘slices’ of the body and demonstrate structures not recognizable on a standard radiograph or tomogram.
New development include a " three-dimensional" presentation of the image which displays on entire bone as if it were a shaded drawing.
A disadvantage, doubtless soon to be overcome, is an inability to show metal without distorting the rest of the image.

Magnetic resonance imaging (MRI): Magnetic resonance imaging (MRI) formerly known as nuclear magnetic resonance (NMR) depends on the behavior of protons in a magnetic fieled rather than radio-density. The protons, or hydrogen nuclei, are first made to line up by exposing the body to a powerful magnetic field. Once they are aligned, the body is exposed to a radiofrequency stimulus which reoriented the nuclei.
When the radiofrequency stimulus is withdrawn, the nuclei swing back to their previous position and this movement can be displayed visually. Tissues containing abundant hydrogen (fat, cancellous bone and marrow) emit high-intensity signals and produce the brightest images, those containing little hydrogen (cortical bone, ligament, tendon and air) appear black; intermediate in the grey scale are cartilage, spinal canal and muscle.

Diagnostic ultrasound (U/S): High-frequency sound waves, generated by a transducer, can penetrate several centimetres into the soft tissues, as they pass through the tissue interfaces some of these waves are reflected back (like echoes) to the transducer, where they are registered as electrical signals and displayed as images on a screen or plate. Depending on their structure, different tissues are referred to as highly echogenic, mildly echogenic or echo-free. Fluid-filled cysts are echo- free; fat is highly echogenic, and semi-solid organs manifest varying degrees of ‘echogenicity’ which permits their spatial identification. Because of the marked echogenic contrast between cystic and solid masses, ultrasonography is particularly useful for identifying hidden " cystic" lesions such as haematomas, abscesses, popliteal cysts and arterial aneurysms. It is also capable of detecting intra-articular fluid and may be used to diagnose a synovial effusion or to monitor the progress of an "irritable hip" and in the early diagnosis of congenital hip dislocation by screaning newborn babies.

One big advantage of this technique is that the equipment is simple and portable and can used almost anywhere. Another is that it produces no harmful side effects.

Radionuclide imaging: Photon emission by radionuclides taken up in specific tissues can be recorded by either a simple rectilinear scanner or a gamma camera, to produce an image which reflects current activity in that tissue or organ.
In current practice, technetium-labelled hydroxymethylen diphosphphonate (^{99m}Tc-HDP) is injected intravenously and its activity is recorded at two stages:

1) shortly after injection, while it is still in the blood stream or the perivascular space (The perfusion or blood pool phase), and
2) 3 hours later when the isotope has been taken up in bone (The bone phase).

Normally, in the early perfusion phase the vascular soft tissues around the joints produce the darkest (most active) image; 3 hours later this activity has faded and the bone outlines are shown more clearly, the greatest activity appearing in the cancellous tissue at the ends of the long bones.
The clinical applications are manifold and include:

(1) The diagnosis of stress fractures or other undisplaced fractures that do not appear on the plain x-ray.
(2) The detection of a small bone abscesses or an osteoid osteoma.
(3) The investigation of loosening or infection aroud prostheses.
(4) The diagnosis of femoral head ischemia in avascular necrosis.
(5) The early detection of bone metastases.

Other radionuclide compounds:

Technetium-labelled sulphur colloid (^{99m}Tc-Sc): Is taken up by phagocytes in the reticuloendothelial system and is therefore a better indicator of marrow vascularity than the bone-seeking compounds.

Gallium-67 (^{67}Ga): Concentrated in inflammatory cells and has been used to identify sites of hidden infection.

Indium-111-labelled leucocytes: Can also be used as makers for infection.

Radiographic examination

- Identify the x-ray film
- Examine methodically the X-ray film according to a standard routine
- Interprete the radiographic findings.

Special Radiographic Techniques

- Find out x-rays using contrast media (sinography, arthrography, myelography and radiography).
- Identify tomography
- identify computed tomography (CT)
- Identify magnetic resonance imaging (MRI)
- Identify diagnostic ultrasound.
- Identify radionuclide imaging.

Methodological Identification & Interpretation Of Radiographs In Orthopaedics.

General Approach

Identify the Patient:-

- Name.
- Age.
- Sex.
- Date.

Identify The Film:-

- Which film.
- Which view
- Which quality :- contrast well the soft tissue and bony tissue.
- Which site.
- Which side.

Identify the Local Findings:-

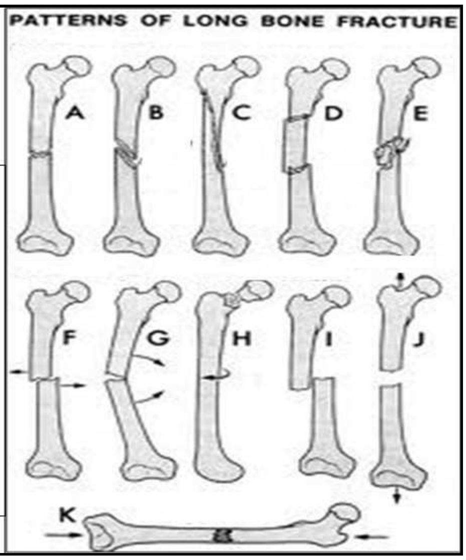
1- Soft Tissue:-

- Shadow of subcutaneous layer.
- Shadow of muscular layer.
- Shadow of soft tissue swelling.
- Subcutaneous gas.
- Soft tissue foreign bodies.

2- <u>Bone:-</u>

- ***Continuity / Pattern of the fracture.***

Fig. 3.1



A- Transverse.
B- Oblique.
C- Spiral.
D- Segmental.
E- Communated.
F- Transverse displacement.
G- Angulation.
H- Rotation.
I- Axial displacement.
J- Distraction.
K- Impaction.

- ***Reguality.***
  - Regular.
  - Irregular.

- ***Change in Shape.***

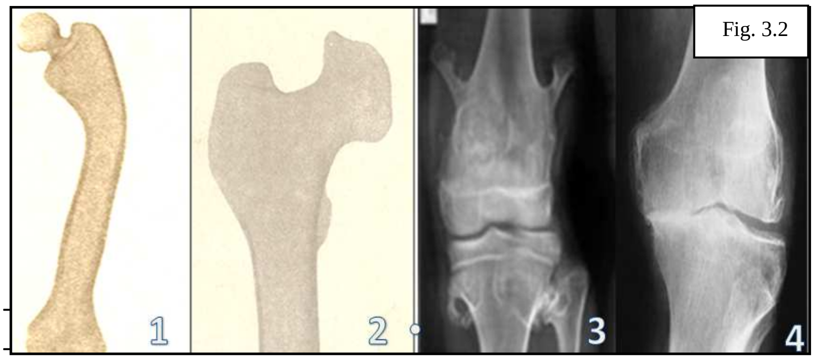


Fig. 3.2

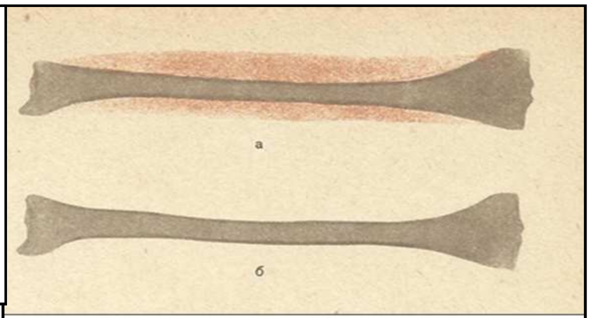
- Angulated bone. (pic.1)
- Deformed Epiphysis.(pic.2)
- Abnormal growth on the bone. exostose (pic.3), osteophyte (pic.4).

- ***Change in the thickness.***

- Increased thickness (hypertrophy, hyperostosis).
- Decreased thickness (atrophic bone).

Fig. 3.3

Change in the width of the bone (thickness)
A- increase width (hypertrophy, hyperostosis).
B- decrease thickness (incomplete growth or atrophy).



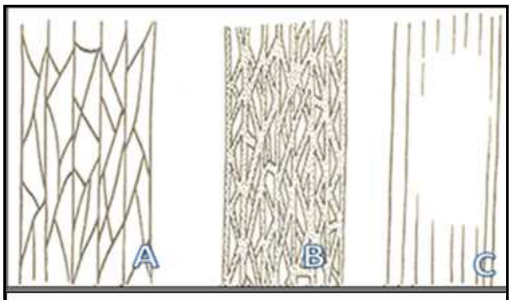
Change in the width of the Bone (thickness)

A- Increase width (hypertrophy, hyperostosis).

B- Decrease thickness (incomplete growth or atrophy).

- ***Change in bone structure (density)***

- Increase density (sclerosis).
- Decrease density (rarefaction or osteoporosis).
- Bone obsorbtion (osteolysis).
- Bone destructive lesion.
- Cyst formation.
- Separation of part of the bone (cortical sequestrum or cancellous sequestrum).



A- Osteoprosis.
B- Sclerosis.
C- Osteolysis.

Fig. 3.4

Fig. 3.5

Change in bone structure:-
A Destruction (destructive lesion).
B Bone obsorbtion (osteolysis), (cyst formation).
C Separation of part of the cortex of the bone (cortical sequestrum) or of the cancellous part Of the bone (cancellous sequestrum).

Fig. 3.6

Change in bone structure:-
A Destruction (destructive lesion).
B Bone obsorbtion (osteolysis), (cyst formation).
C Separation of part of the cortex of the bone (cortical sequestrum) or of the cancellous part Of the bone (cancellous sequestrum).

- ***Change in the Cortex***

A- Separation of the periosteum (periostitis, periosteal reaction).
B- Irregularity of the periosteum.
C- Ossification of the periosteum at the tumour margins.
D- Ossification along the vertical periosteal blood vessels from the periosteum to the bone.
E- Thickness of the periosteum as a result of multiple layers formation due to periosteal reactions.(onion-like appearance).

Periosteal changee:-
A Periosteitis (periosteal reaction) periosteal separation.
B Eroded periosteiyis, irregular.
C Transformation of the periosteum into bone, (ossification of the periosteum) at the border of the tumour.
D Ossification along the vessels going from the periosteum toword the bone (needle periosteitis) or sunrays appearens.
E Thickening of the periosteum due to repeated periosteal reaction and sepration (periostosis) (onion-like appearance).

Fig. 3.7

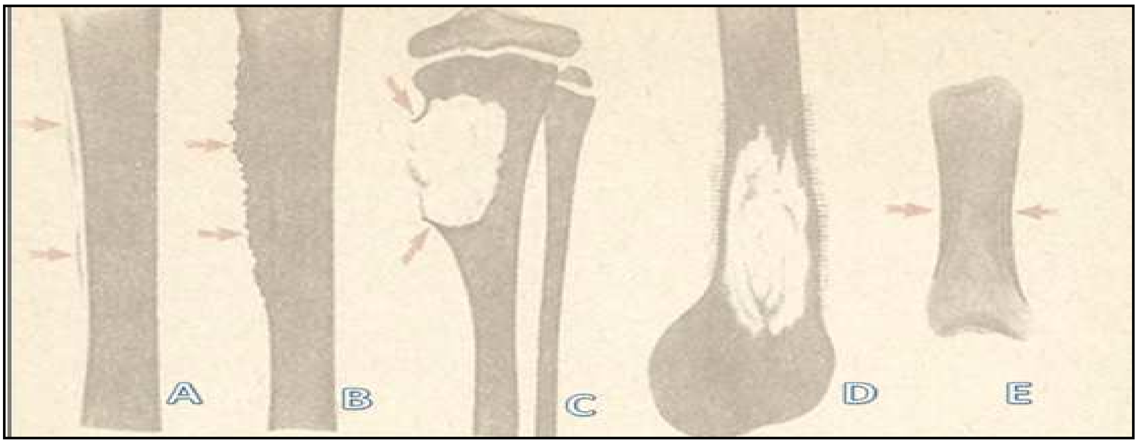


Fig. 3.8

Periosteal changes:-

A- Periosteitis (periosteal reaction) periosteal sepration.

B- Eroded periosteitis, irregular.

C- Transformation of the periosteum into bone, (ossification of the periosteum) at the border of the tumour.

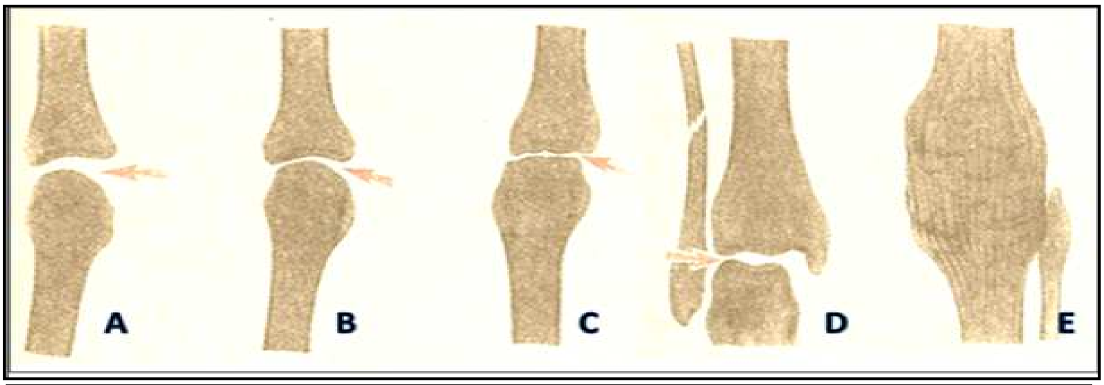
D- Ossification along the vessels going from the periosteum toword the bone (needle periosteitis) or sunrays appearance.

E- Thickness of the periosteum due to repeated periosteal reaction and sepration (periostosis), (onion like appearance)

3- Joints:-

- ***Articular space***

- Wide.
- Narrow, unilateral, Bilateral.
- Obliterated, unilateral, Bilateral (complete fusion).



Change in the joint space

A- Increase joint space (hypertrophy) of the cartilage or joint effusion.
B- Decrease joint space (narrow), regular both site of the joint (bilateral), one site of the joint (unilateral), atrophy or destruction of the cartilage.
C- Irregular decrease in the joint space (subchondral bone erotion due to cartilage destruction).
D- Fracture subluxation (a form of change of the joint space).
E- Obliteration of the joint space or fusion of the joint (ankylosis).

Fig. 3.9

- ***Articular surface***

1. Normal contact.
2. Complete loss of contact (dislocation).
3. Partial loss of contact (subluxation).

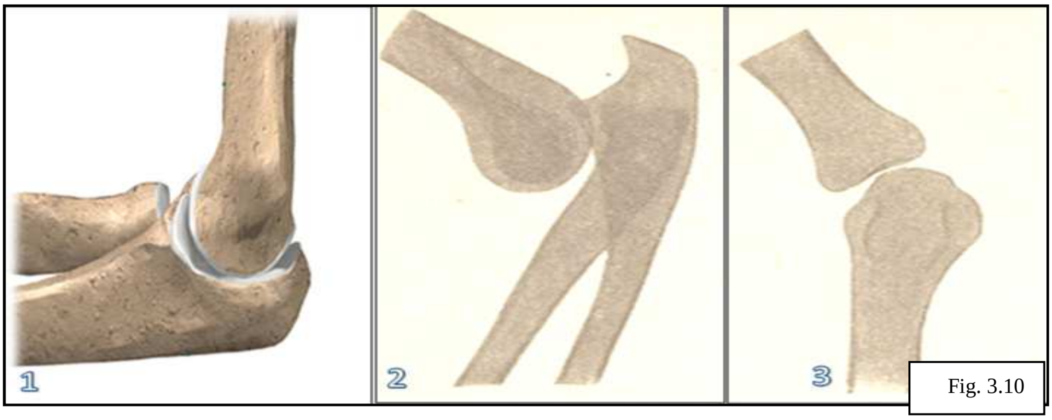


Fig. 3.10

- ***Articular margin***

4. Regular.
5. Irregular.
6. Bone prominence (osteophyte).

- ***Subchondral bone***

7. Cysts.
8. Rarefaction.
9. Sclerosis.

Fig. 3.11

Radiographs of the vertebral column

1- Numerating the vertebrae.
   - Descending method. From landmark downward.(7th cervical vertebrae, 12th thoracic ..ect)
   - Ascending method. From landmark upward. (1st sacrum, 12th thoracic ..ect)

2- Change in normal curvatures.
   - Kyphosis. Increase the curve forword.
   - Scoliosis. Lateral curvature.
   - Flat (straight).

3- Measure the height of the vertebrae on antero-posterior & lateral views and compare with one above and one below it.

4- Measure the width of the vertebrae on antero-posterio & lateral views and compare with one above and one below it.

5- Measure the height of the intervertebral space.

6- The relationship of the vertebrae to the one above it and one below it. Displaced laterally, forword or backword.

7- Detect the eyes of the vertebrae (the base of each attached pedicle to the vertebral body). Rotation of the eyes indicates fixed scliosis.

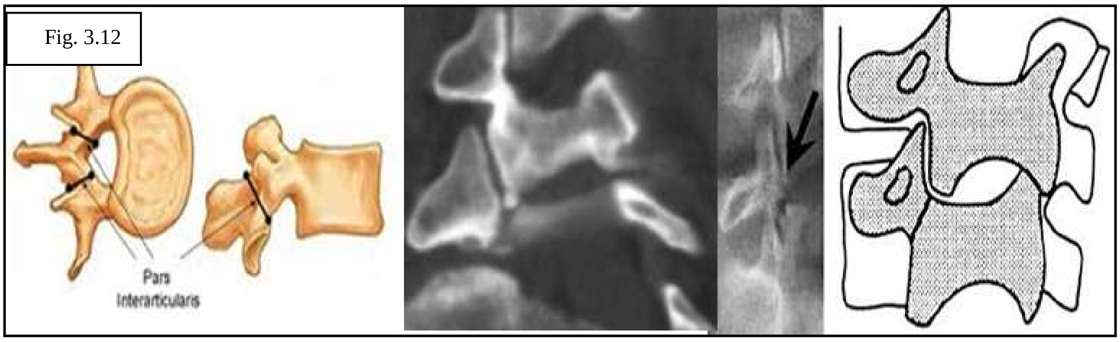
8- The nose of the vertebrae (the spinous process).

9- The ear of the vertebrae (the transverse process).

10- Measure the distance between the pedicles in antero-posterior view. (increase distance indicates compression fracture).

11- Look to the pars interarticularis in the oblique view.

Fig.(1) A,B.C Pars interarticularis defect.



The Rule Of Two

Two views (three or four views sometimes required).
AP-----------PA- patella
Lat.
Oblique (in supination or in pronation)
Cephalic or Qaudal (pelvis)

Two occasions,
Immeditly after trauma and few days later. (scaphoid fracture).
Two joints
(one above and one below).
Two sides
(to compare between them).
Two distances.
Avoide extreme positions, do not be too close to the film or too far from it.
Two brains
Always discuss your openion with others (pathologist, radiologist, ect).

Chapter 4
The Shoulder

❖ The shoulder girdle is composed of three joints and one articulation.

1) The sterno-clavicular joint.
2) The acromio-clavicular joint.
3) The gleno-humeral joint (the shoulder joint).
4) The scapula-thoracic articulation.

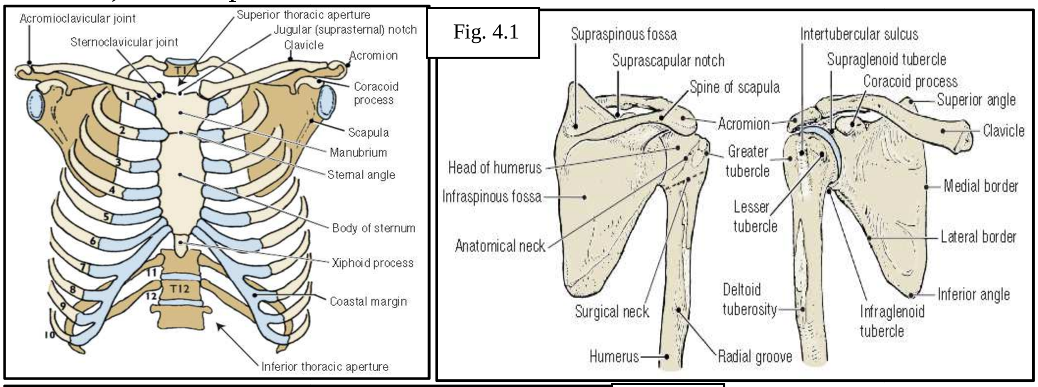


Fig. 4.1

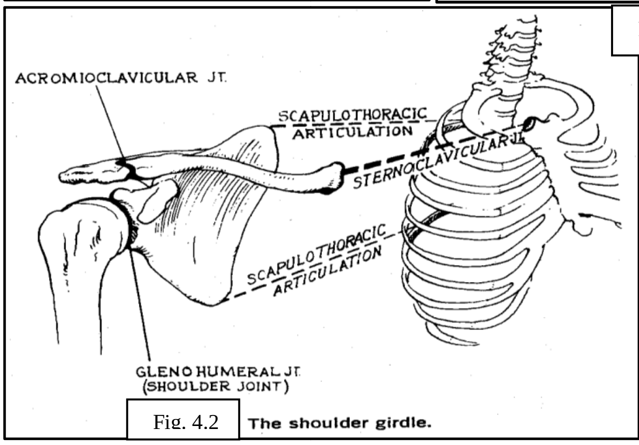


Fig. 4.2 **The shoulder girdle.**

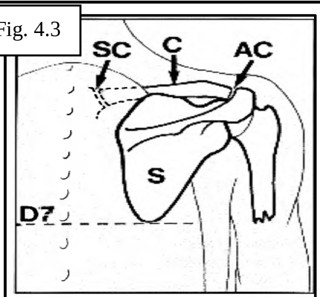


Fig. 4.3

Fig. 4.B: In the scapulothoracic joint the scapula (S), moves over the rib cage and serratus anterior. It is supported by the *clavicle* (C) (which articulates with the scapula at the acromioclavicular joint (AC), and with the sternum at the sternoclavicular joint (SC)), and by *trapezius*, *rhomboids*, *levator scapulae* and *serratus anterior.* The inferior angle of the scapula normally lies at the level of D7.

- ➢ Expose the patient to the waist.
- ➢ Examine the patient on standing position (setting or lying position if necessary).
- ➢ Examine the patient according to the system: look, feel, measure, move, stress, power, sensation, reflexes, distal pulse.

Look (inspection): From in front: For any changes on the following:

- *Skin.*
- *Soft tissue.*
- *Bone.*

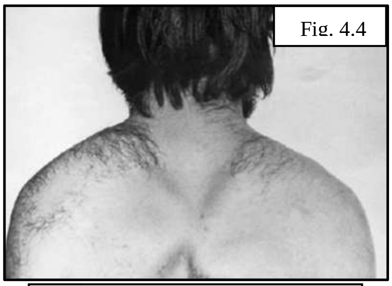


Fig. 4.4

Webbing neck in Klippel-Feil

Skin:

- ➢ Change in colour.
- ➢ Sinus or scars.
- ➢ Odema.
- ➢ Webbing of the skin at the root of the neck (klippel-Feil syndrome).

Soft tissue:

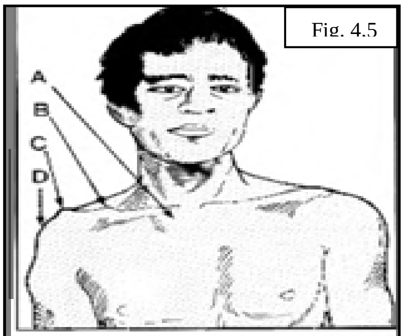
- ➢ Wasting of the muscles around the shoulder (example: deltoid wasting due to disuse or axillary nerva palsy).

- Change in the contour of the muscles or absent muscles around the shoulder.

Bone:

- Any changes in the sterno-clavicular joint.
- Deformity of the clavicle.
- Any changes in the acromio- clavicular joint.

Fig. 4.5



Inspection (1): *the front:* Note whether any of the following are present: (A) Prominent sternoclavicular joint (subluxation). (B) Deformity of clavicle (old fracture). (C) Prominent acromioclavicular joint (subluxation or osteoarthritis). (D) Deltoid wasting (disuse or axillary nerve palsy).

Fig. 4.6 ***Rupture Of Biceps***

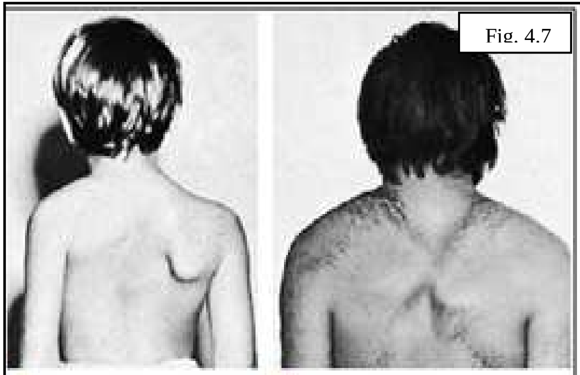
Inspection: from the side:

- Swelling of the joint (inflammation or infection).

From behind:

- Shape of the scapula.
- Size and level of the scapula (small and high scapula in sprengel shoulder and klippel-feil syndrome), or
- Winging scapula due to paralysis of serratus anterior.

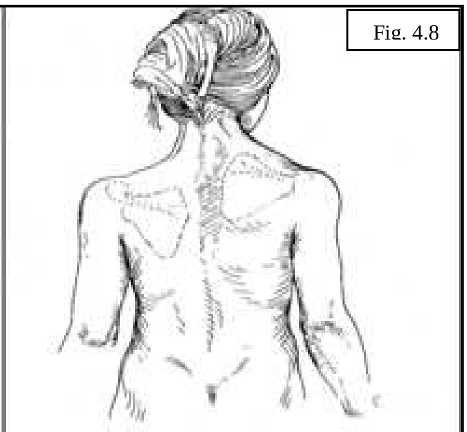
Fig. 4.7



(a) (b)

Scapular disorders (a) Sprengel shoulder; (b) Klippel-Feil syndrome.

Fig. 4.8



The scapulae—Sprengel's deformity—partially undescended scapula.

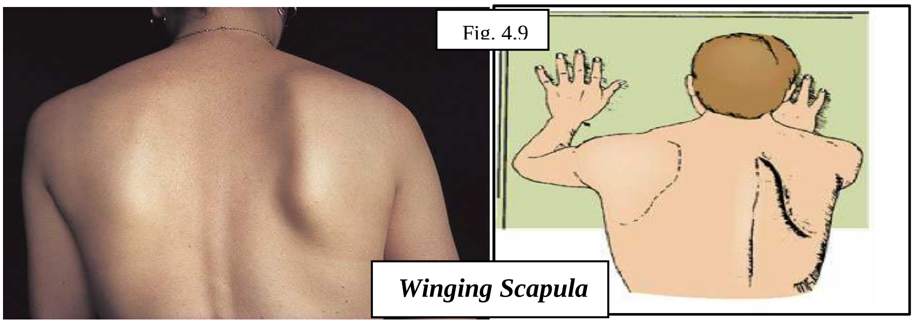


Fig. 4.9

Winging Scapula

From above:

- Look for:
  - ➢ Swelling of the shoulder.
  - ➢ Deformity of the clavicle.
  - ➢ Asymmetry of the supraclavicular fossa.

Feel (palpation):

<u>Skin :</u>

- ➢ Hotness.
- ➢ Dry or wet.
- ➢ Odematous.
- ➢ Smooth or rough.
- ➢ Tender.

<u>Soft tissue:</u>

- The contour of the muscle
  - ➢ Deltoid.
  - ➢ Pectoralis major.
  - ➢ Latissmus dorsi.
- The axillary fossa
  - ➢ Lymph nodes.
- Tenderness of the joint capsule, at the rotator cuff muscle insertion on the greater tuberosity. (The Supraspinatus, Infraspinatus, Teres minor and Subscapularis muscle). Since the rotator-cuff lies directly below the acromion, it must be rotated out from underneath before it can be palpated. Passive extension.

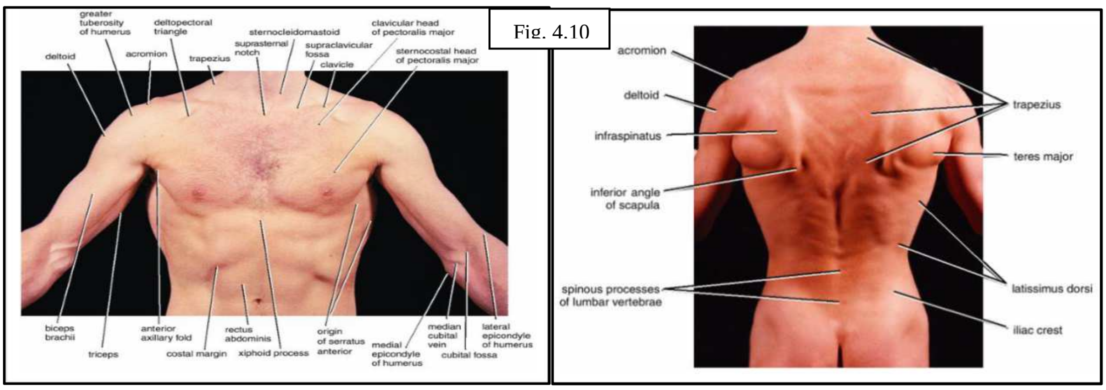
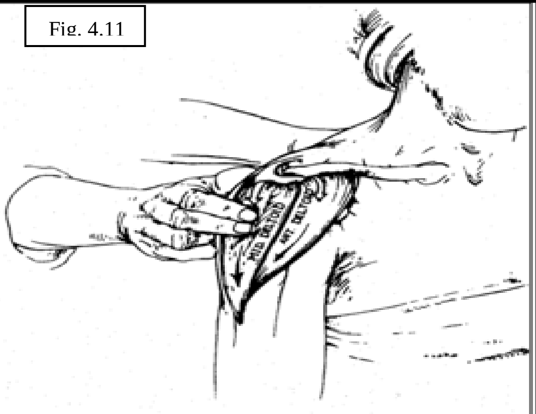


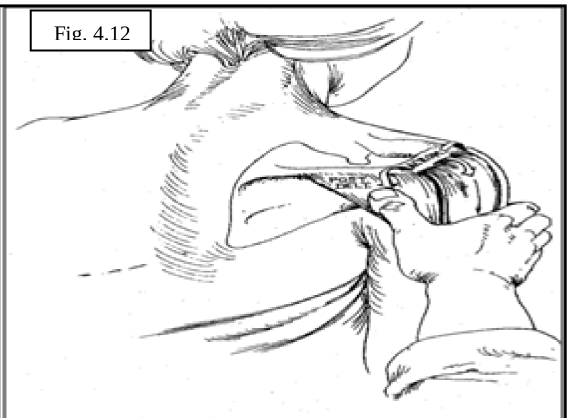
Fig. 4.10

Fig. 4.11



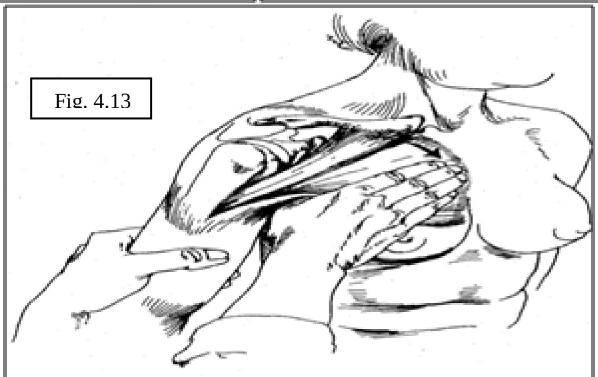
The anterior and middle portions of the deltoid.

Fig. 4.12



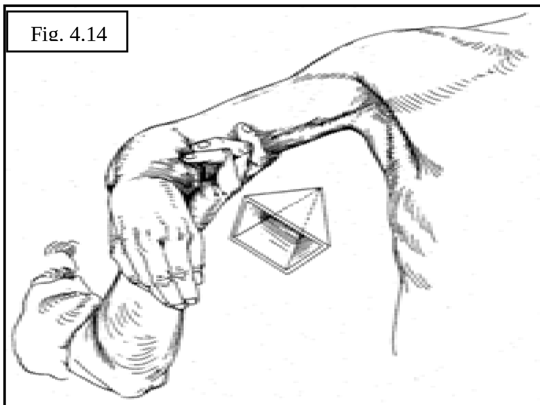
The posterior deltoid.

Fig. 4.13



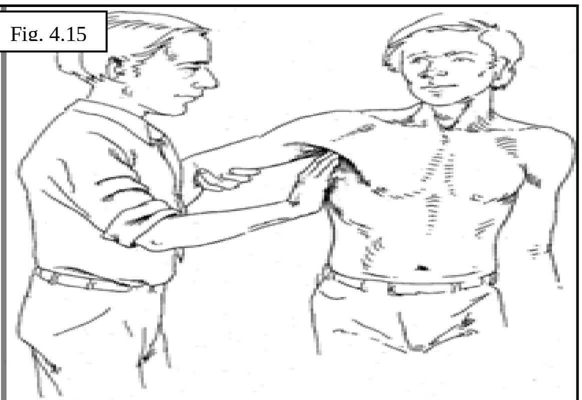
Palpation of the pectoralis major muscle.

Fig. 4.14



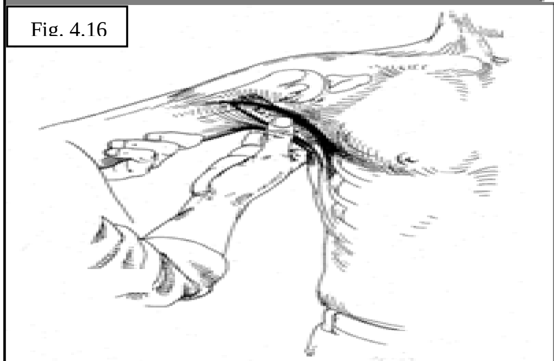
The axilla is pyramidal in shape.

Fig. 4.15



Palpation of the axilla.

Fig. 4.16



Palpation of the latissimus dorsi—the posterior wall of the axilla.

Fig. 4.17

The pectoralis major muscle—the anterior wall of the axilla.

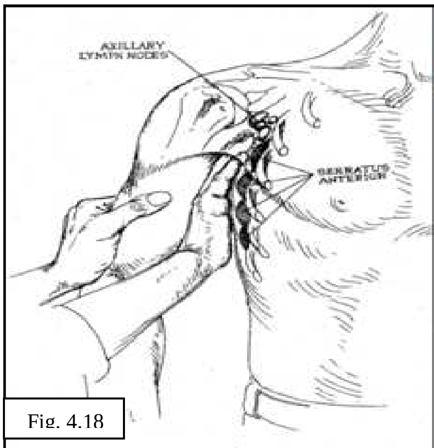
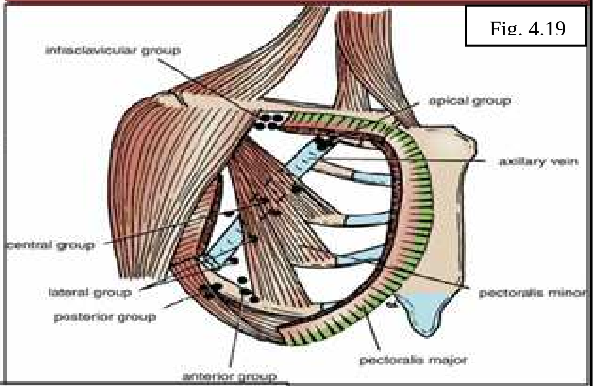


Fig. 4.18

Probe of lymph node enlargements.

Lymph node groups of axilla

Fig. 4.19



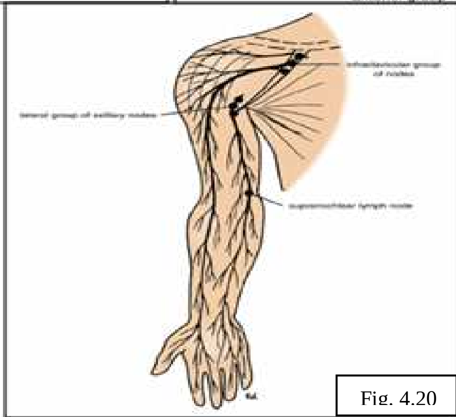
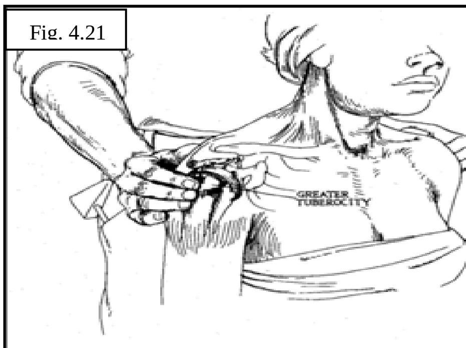


Fig. 4.20

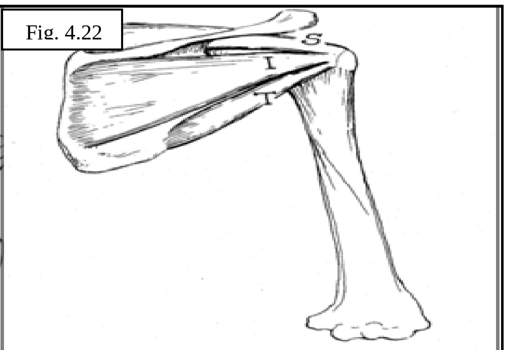
Lymph nodes of axilla and upper limb

Fig. 4.21



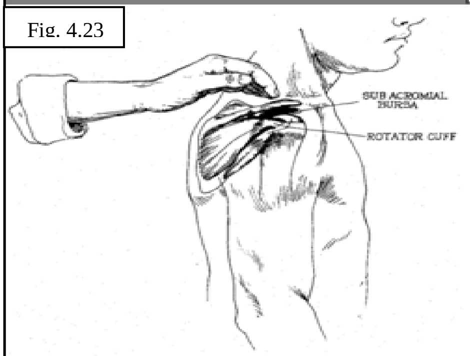
The greater tuberosity of the humerus.

Fig. 4.22



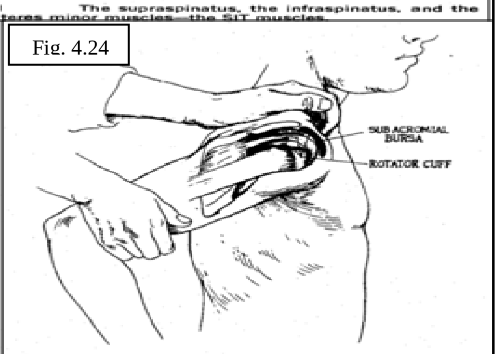
The supraspinatus, the infraspinatus, and the teres minor muscles—the SIT muscles.

Fig. 4.23



The rotator cuff lies underneath the acromion.

Fig. 4.24



Passive extension of the shoulder moves the rotator cuff into a palpable position.

Bone:

- For any tenderness, deformity, swelling in the following:
  - ➢ Sterno-clavicular joint.
  - ➢ Acromio-clavicular joint.

- Clavicle.
- Gareater tuberosity.
- Glenoid margins.
- Exostoses in the axillary area.

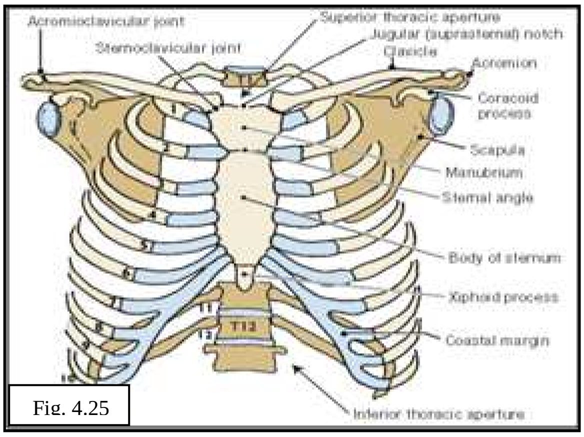


Fig. 4.25

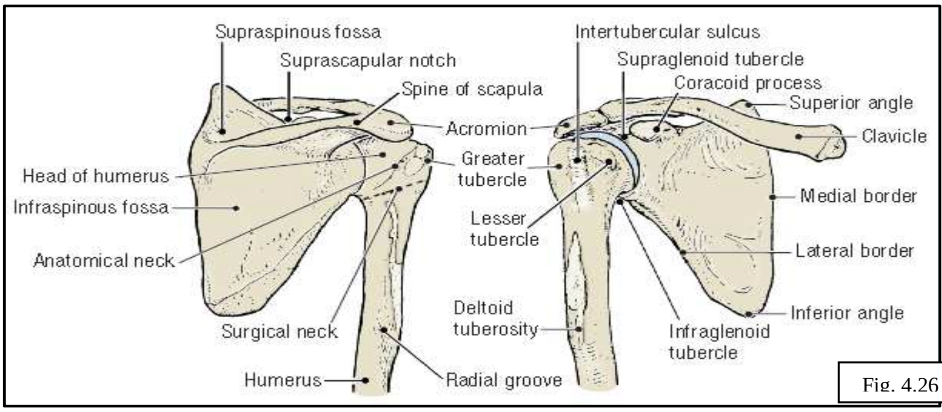


Fig. 4.26

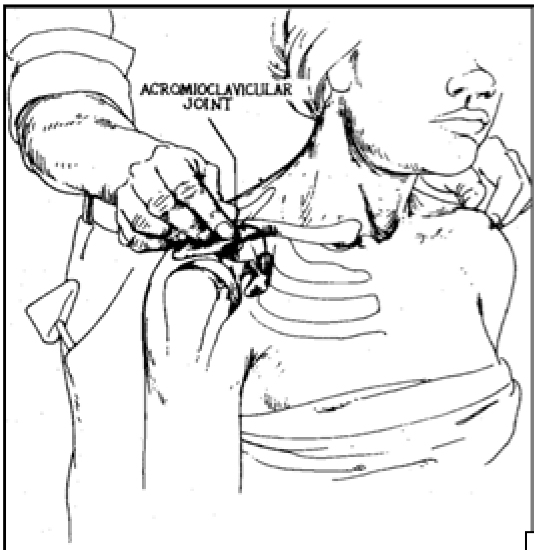


Fig. 4.27 The acromioclavicular articulation.

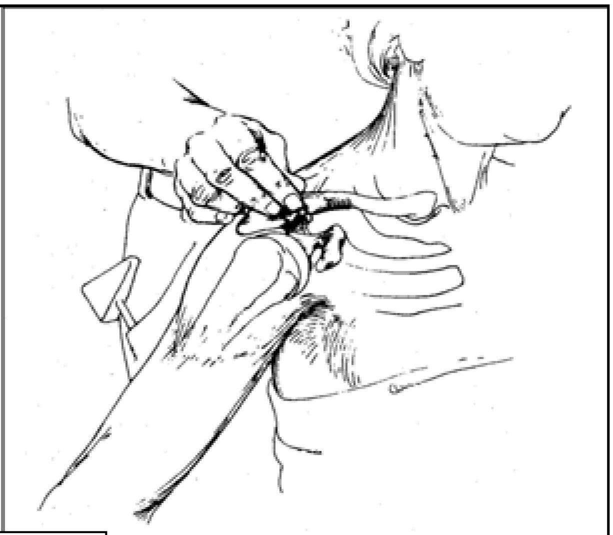
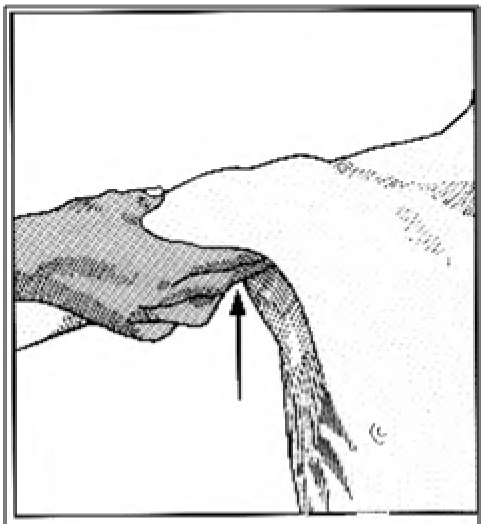


Fig. 4.28 Palpation of the acromioclavicular articulation is easier if the patient rotates his arm.



Palpation (2): Continue the examination by palpating the upper humeral shaft and head via the axilla. Exostoses of the proximal humeral shaft are often readily palpable by this route.

Fig. 4.29

Measurement:

- Measure the whole length of the upper limb.
- Measure the girth of the shoulder at a mid-point between the acromial process and the lateral humeral epicondyle.

Movement : (*Active and passive*)

Abduction:

- Ask the patient to abduct both arms.
- Observe the smoothness of the movement and the range achieved.
- A full, free and painless range is rare in the presence of any significant pathology in the shoulder region.
- Note any difficulty in initiating abduction (Difficulty in doing so is suggestive of a shoulder cuff (or supraspinatus tendon) tear.
- Measure the range of abduction:
  - ✓ In the normal shoulder, the arm can touch the ear with only slight tilting of the head.
  - ✓ Normal range : 0-170^o

Forward flexion:

- Ask the patient to swing the arm forwards and lift it above his head.
- View the patient from the side.
- Normal range: 0-165^o

Backwards extension:

- Ask the patient to swing the arm directly Backwards,
- again viewing and measuring from the side.
- Normal range : 0-60^o

Horizontal flexion and adduction:

- Occasionally measurement of this angle may be helpful, but it need not be routine.
- View the patient from above.
- The arm is moved forwards from position of the 90^o abduction.
- Normal range: 0-140^o

Rotation screening tests:

For internal rotation in extension: Ask the patient to place the hand behind the opposite shoulder blade.

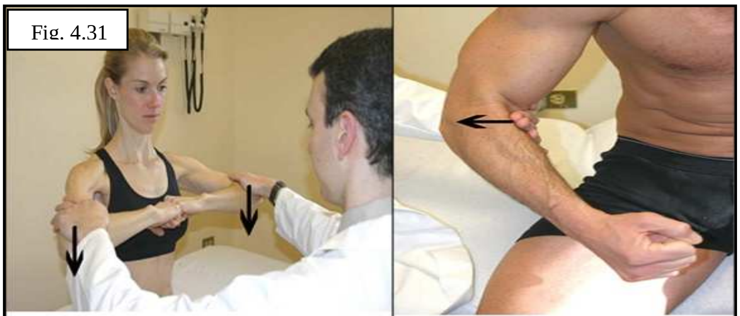
For External rotation at 90^o abduction:

- Ask the patient to place both hands behind the head.
- Compare the two sides. Lack of success or restriction is common in frozen shoulder.

Fig. 4.30

Apley Scratch test for shoulder internal rotation and abduction. | Apley Scratch test for external rotation and abduction. | Shoulder internal rotation and adduction

Fig. 4.31



Resisted shoulder abduction. | Resisted shoulder adduction.

Fig. 4.32

Resisted shoulder external rotation. | Resisted shoulder internal rotation.

Power:

- Examine the power of the muscles around the shoulder. Mainly the deltoid, biceps, rotator cuff muscles and serratus anterior.

Deltoid power:

Ask the patient to try to keep the arm elevated in abduction while you press down on his elbow: look and feel for deltoid contraction.

Fig. 4.33

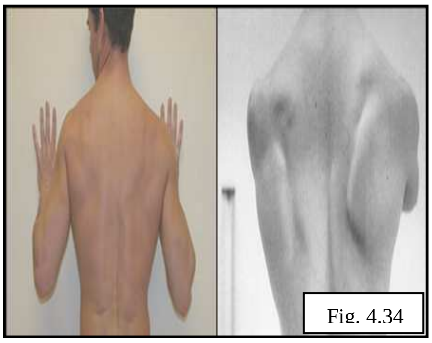


Fig. 4.34

Serratus anterior:

Where paralysis of serratus anterior is suspected, ask the patient to lean with both hands against a wall, any tendency to winging of the scapula immediately becomes apparent .

Long head of biceps:

Support the patient 's elbow with one hand. Grasp his wrist, and ask him to pull toward his shoulder, while you resist this movement. If the long tendon of biceps is ruptured, the belly of biceps will appear globular in shape, compare both sides.

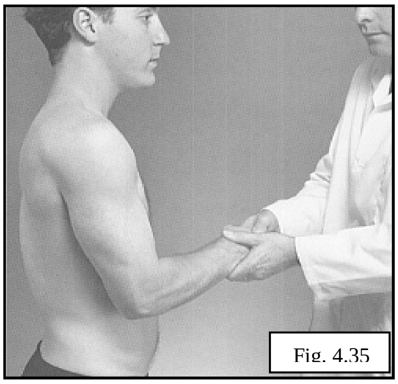


Fig. 4.35

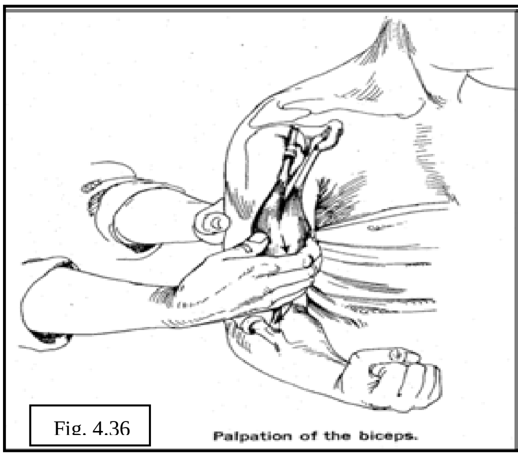


Fig. 4.36 Palpation of the biceps.

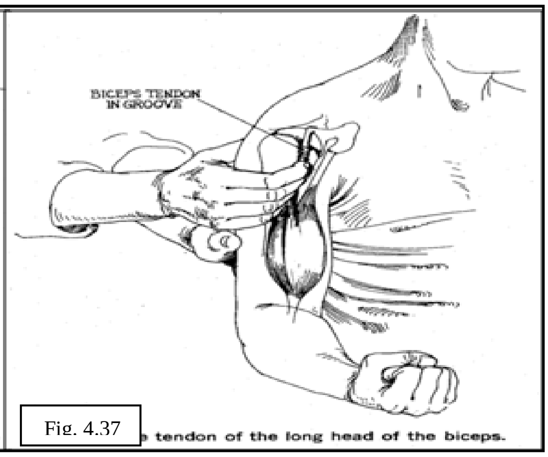


Fig. 4.37 ...e tendon of the long head of the biceps.

❖ **palpation of the brachial artery in the axilla:**

The axilla (armpit) is a quadrilateral pyramidal structure through which vessels and nerves pass to the upper extremity.

The fleshy anterior wall of the axilla is formed by the pectoralis major muscles, and the posterior wall, also fleshy, by lastissimus dorsi muscles.

The medial wall is defined by ribs two to six and the overlying serratus anterior muscles, and the lateral wall by the bicepital groove of the humerus .

The glenohumeral joint represents the apex of the pyramid, and the webbed skin the fascia of the armpit, the base. The axillary artery and proximal portion of the brachial artery is the most obvious palpable structure in the lateral quadrant.

Its pulse can be felt when gentle pressure is applied against the shaft of the humerus between the ropelike coracobrachialis muscle and the long head of the triceps.

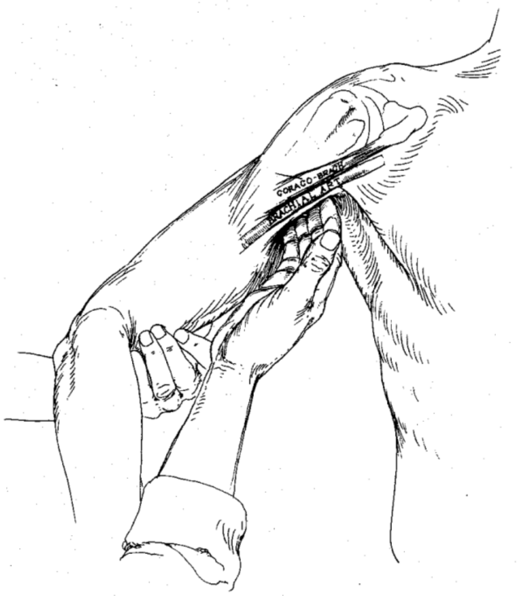


Fig. 4.38 lpation of the brachial artery.

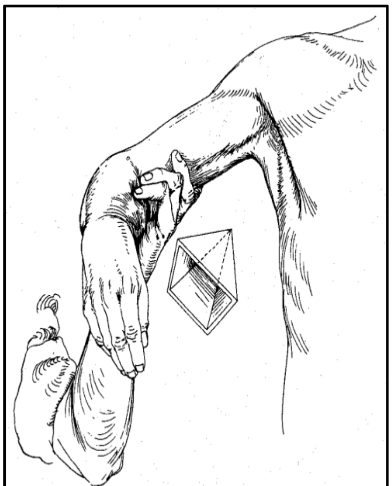


Fig. 4.39 he axilla is pyramidal in shape.

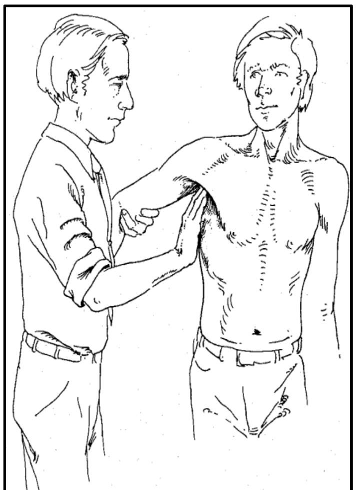


Fig. 4.40 ation of the axilla.

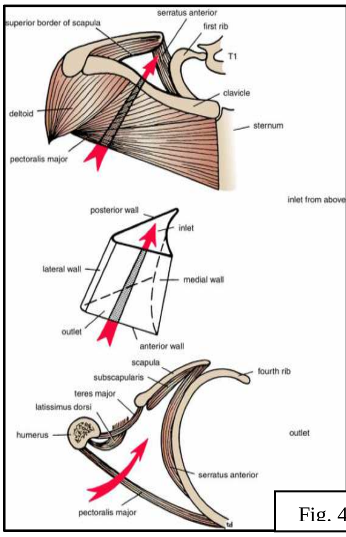


Fig. 4.41

- Examine the sensation over the regimental badge area at the lateral aspect of the shoulder at the mid of the deltoid muscle. Loss of sensation in this area indicate axillary nerve injury (C_5).

❖ No reflexes in the shoulder.

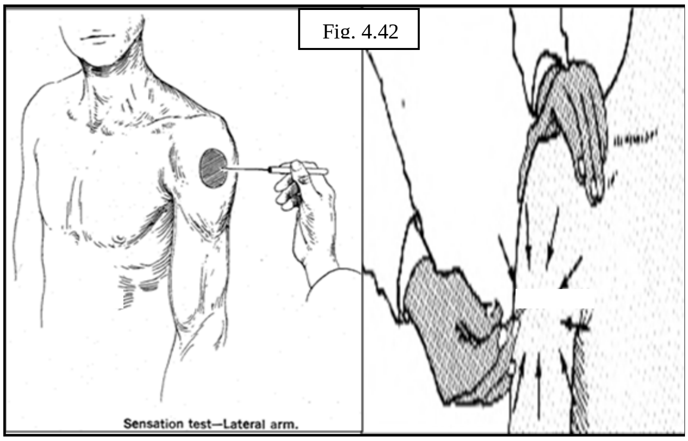


Fig. 4.42

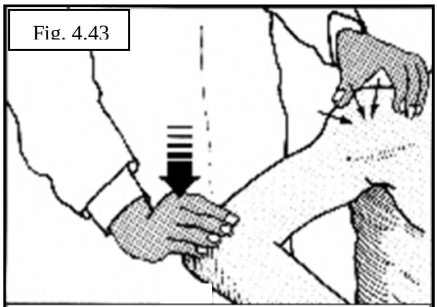


Fig. 4.43

Deltoid power: Ask the patient to try to keep the arm elevated in abduction while you press down on his elbow; look and feel for deltoid contraction. Traction injuries of the axillary nerve resulting in deltoid involvement are seen most frequently after dislocations of the shoulder. If axillary nerve palsy is suspected, test for sensory loss in the 'regimental badge' area on the lateral aspect of the arm.

Special test:

<u>Test for crepitetions:</u>

- Place one hand over the shoulder, with the middle finger lying along the acromio-clavicular joint. Abduct the arm by the other hand .

  Detect any crepitations coming from the shoulder, and locate their source (gleno-humeral or acromio-clavicular).

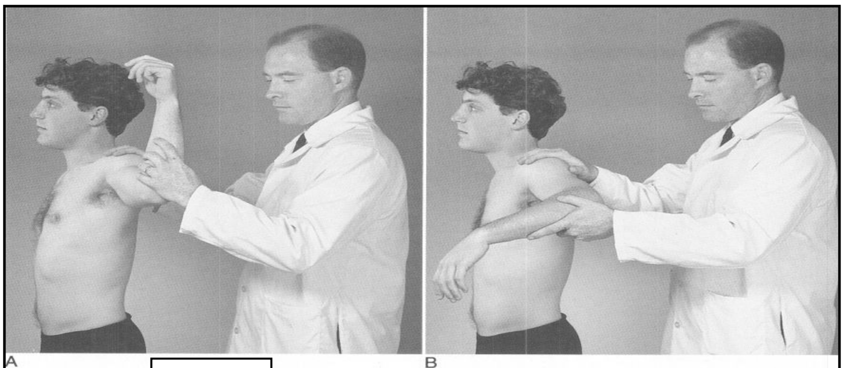


Fig. 4.44

A and *B*, Passive shoulder rotation to elicit soft tissue crepitus.

<u>Gerber and Ganz drwer test for recurrent shoulder dislocation:</u>

- when recurrent *anterior* dislocation is suspected, support the (supine) patient's relaxed arm against your side, with his shoulder in 90^o abduction, slight flexion and external rotation.

  Steadying the scapula with the thumb on the coracoid and the fingers behind, try to move the humeral head anteriorly with your other hand. Observe any movements, clicks, and patient apprehension.

- where recurrent *posterior* dislocation is suspected, hold the relaxed, supine patient's forearm with the elbow flexed and the shoulder in 20^o flexion and 90^o abduction.

  Place the thumb just lateral to the coracoid.

Now internally rotate the shoulder and flex it to backwards with the thumb; any backward displacement of the humeral head should be detected with the thumb.

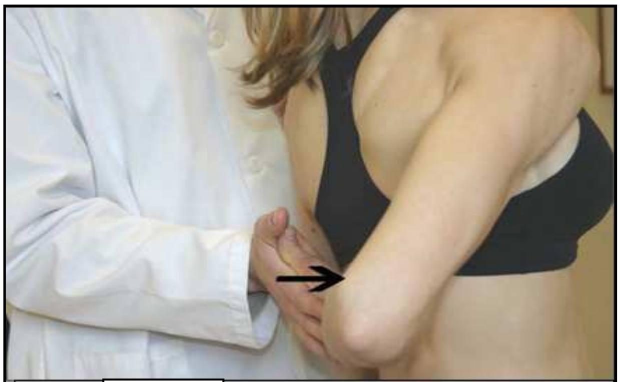


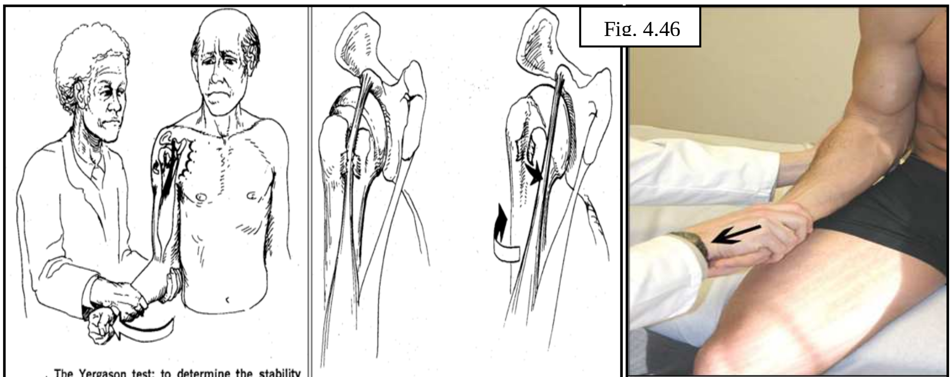
Fig. 4.45 **Gerber Test**

The Yergason test:

This test determines whether or not the biceps tendon is stable in the bicipital groove.

To conduct this test, instruct the patient to fully flex his elbow. Then grasp his flexed elbow in one hand while holding his wrist with your other hand. To test the stability of the biceps tendon, externally rotate the patient's arm as he resists, and at the same time, pull downward on his elbow. If the biceps tendon is unstable in the bicipitel groove, it will pop out of the groove and the patient will experience pain. If the tendon is stable, it will remain secure and the patient will experience no discomfort.

Fig. 4.46



Yergason test

The apprehension test for shoulder dislocation:

To test for recurrent shoulder dislocation, abduct and externally rotate the patient's arm to a position where it might easily dislocate.

If his shoulder is ready to dislocate, the Patient will have a noticeable look of apprehension or alarm on his face and will resist further motion.

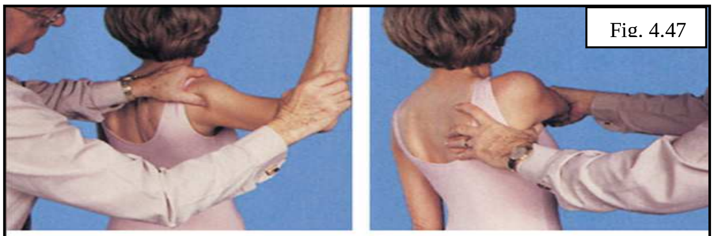


Fig. 4.47

(a) (b)

Shoulder instability, the apprehension test
(a) This is the apprehension test for anterior subluxation or dislocation. Abduct, externally rotate and extend the patients shoulder while pushing on the head of the humerus. If the patient feels that the joint is about to dislocate, she will forcibly resist the manoeuvre.
(b) Posterior dislocation can be tested for in the same way by drawing the arm
forward and across the patients body (adduction and internal rotation).

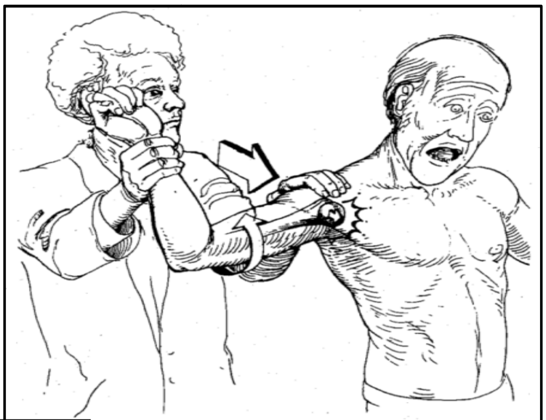


Fig. 4.48 The apprehension test for shoulder dislocation.

The Drop arm test:

Fig. 4.49

Tears in the rotator cuff.

This test detect whether or not there are any tears in the rotator cuff.
First, instruct the patient to fully abduct his arm. Then ask him to slowly lower it to his side.
If there are tears in the rotator cuff (especially in the supraspinatus muscle), the arm will drop to the side from a position of about 90^{o} abduction. The patient still will not be able to lower his arm smoothly and slowly no matter how many times he tries. If he is able to hold his arm in abduction, a gentle tap on the forearm will cause the arm to fall to his side.

Fig. 4.50

Torn supraspinatus (a–d) Partial tear of left supraspinatus: the patient can abduct actively once pain has been abolished with local anaesthetic. (e–g) Complete tear of right supraspinatus: active abduction is impossible even when pain subsides (f), or has been abolished by injection, but once the arm is passively abducted, the patient can hold it up with her deltoid muscle (g).

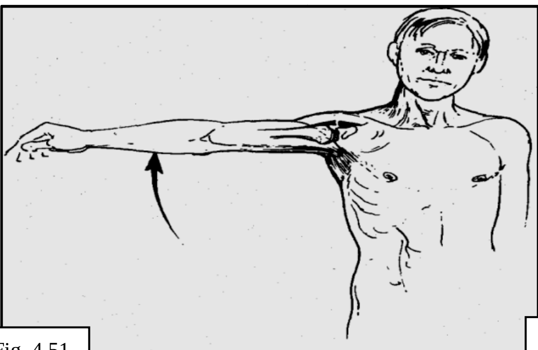


Fig. 4.51 The drop arm test: to determine if there are tears in the rotator cuff.

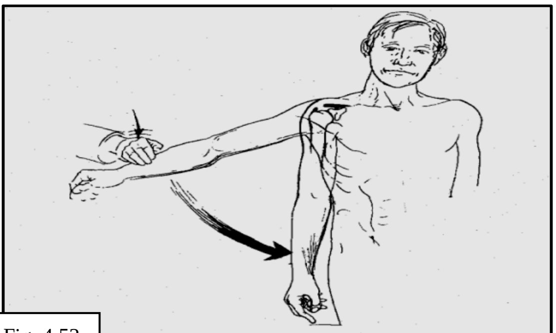


Fig. 4.52 If there are tears in the rotator cuff, the arm drops and the patient is unable to lower his arm slowly to his side.

Test for painful arc syndrome:

- Five primary lesions can give rise to the syndrome:

  1) Minor (Incomplete) tear of supraspinatus tendon.

  2) Supraspinatus tendinitis.

  3) Calcified deposition in supraspinatus tendon.

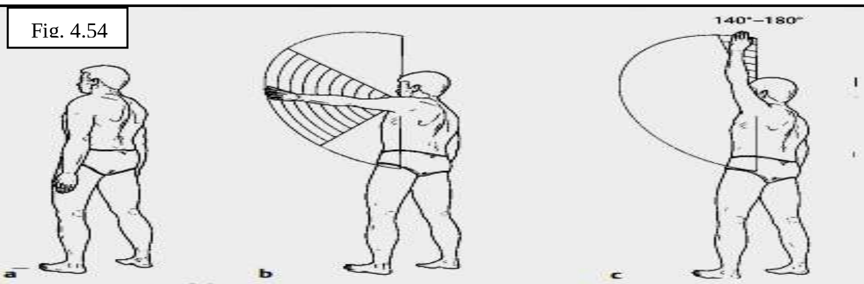
  4) Subacromial bursitis.

  5) Injury of greater tuberosity. (Crack fracture of greater tuberosity)
- Ask the patient to abduct to shoulder. During abduction of the arm pain begins at about 45 degrees and persists through the arc movement up to 160 degrees, thereafter the pain lessens or disappears.

13.8 The painful arc (a,b) In abduction, scapulo-humeral rhythm is disturbed on the right and the patient starts to experience pain at about 60°. (c,d) As the arm passes beyond 120° the pain eases and the patient is able to abduct and elevate up to the full 180°.

Fig. 4.53

Fig. 4.54



Painful arc:
a starting position.
b pain between 30° and 120° (sign of a supraspinatus syndrome).
c pain between 140° and 180° (sign of osteoarthritis in the acromioclavicular joint)

Examination of related areas:

- Since the shoulder is a classic area for referred pain, it is necessary in a complete examination to include an examination of those areas know to refer pain to it.
- A coronary (myocardial infarction) may radiate pain to left shoulder. Shoulder symptoms may also be related to irritation of the diaphragm, which shares the same root innervations (C_4,C_5) as the dermatome covering the shoulder's summit. Therefore the chest and upper abdomen should be carefully examined to determine if symptoms of pathology associated with them are being referred to the shoulder.
- Problems of the neck, such as a herniated cervical disc or other general trauma, may also radiate pain to the shoulder or scapula. This type of radiating pain from the neck area is often felt at the superior medial angle of the scapula.
- Sometimes, a spinal fracture, in addition to causing local pain, may radiate pain to the shoulder along the course of any muscle affected by the fracture. For example, if there is a fracture of the cervical spine, the Rhamboids may transmit pain to the scapula.
- The shoulder may also be effected by pathology of the elbow and the distal end of the humerus, where a fracture can radiate pain proximally to the shoulder.

Fig. 4.55

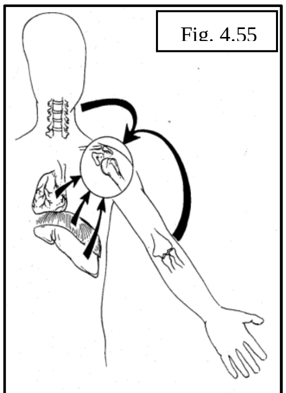


Fig. 75. Areas around the shoulder sometimes refer or radiate pain to the shoulder.

The shoulder

❖ *The painful shoulder:*

Referred pain	***Rotator cuff disorder***	***Joint disorder***
1- Cervical spondylosis. 2- Mediastinal pathology. 3- Cardiac ischaemia.	1- Tendinitis. 2- Rupture. 3- Frozen shoulder.	1- Glenohumeral arthritis. 2- Acromioclavicular arthritis.
Instability	***Bone lesions***	***Nerve injury***
1- Dislocation. 2- Subluxation.	1- Infection. 2- Tumours.	1- Suplascapular nerve. ????? 2- Entrapment.

❖ *X-Ray of the shoulder:*

- At least two x-ray views should be obtained:

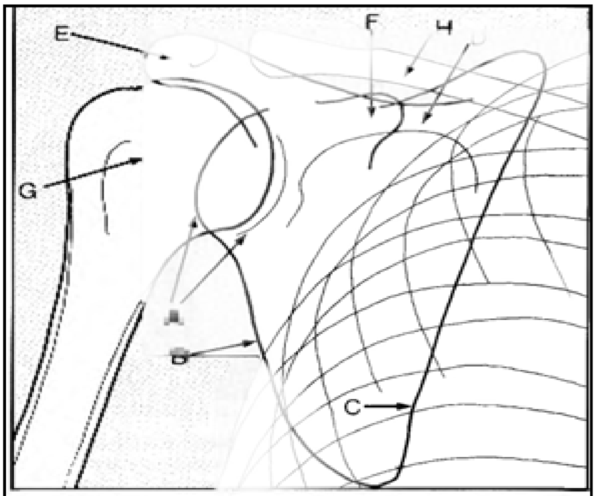
(1) An anteroposterior in the plane of the shoulder and,

(2) An axillary projection with the arm in abduction to show the relationship of the humeral head to the glenoid.

Fig. 4.56

(a) (b) (c) (d)

13.4 Imaging (a) Anteroposterior x-ray. (b) Axillary view showing the humeral head opposite the shallow glenoid fossa, and the coracoid process anteriorly. The acromion process shadow overlaps that of the humeral head. (c) Lateral view; the head of the humerus should lie where the coracoid process, the spine of the scapula and the blade of the scapula meet. (d) MRI. Note (1) the glenoid, (2) the head of the humerus, (3) the acromion process and (4) the supraspinatus (with degeneration of the tendon).



Radiographs (2): The standard shoulder projection is taken in recumbency. Examine the radiograph methodically by identifying (A) the glenoid, (B) the lateral border of the scapula, (C) the medial border of the scapula, (D) the spine of the scapula, (E) the acromion, (F) the coracoid. Note the relations of (G) the humeral head and (H) the clavicle to the glenoid and the acromion.

Fig. 4.57

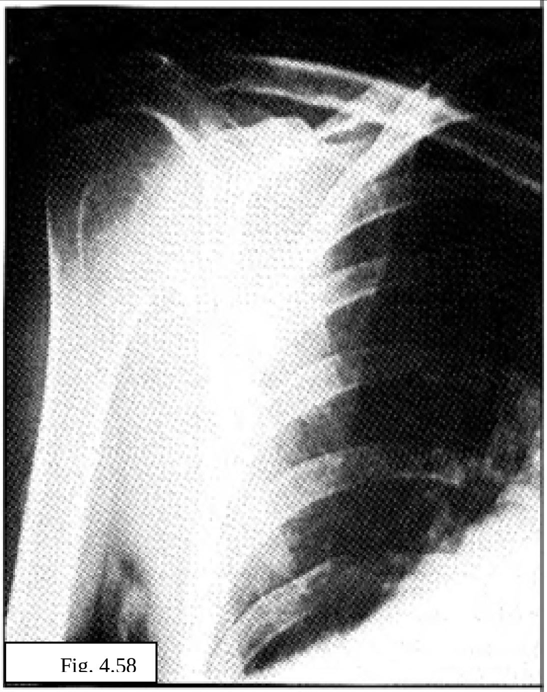


Fig. 4.58

Radiographs (1): In screening the shoulder an anteroposterior projection is usually carried out, although additional views are highly desirable. This shows a typical normal film.

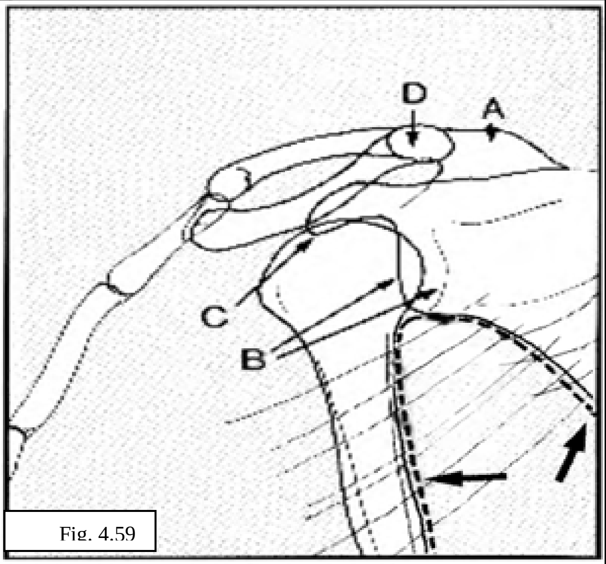


Fig. 4.59

Radiographs (8): *Normal translateral (2)*: Note (A) scapular spine; (B) glenoid; (C) coracoid; (D) acromioclavicular joints and superimposed clavicular shadows. Note the parabolic curve formed by the humeral shaft and the lateral border of the scapula. This is disturbed in most shoulder dislocations and subluxations.

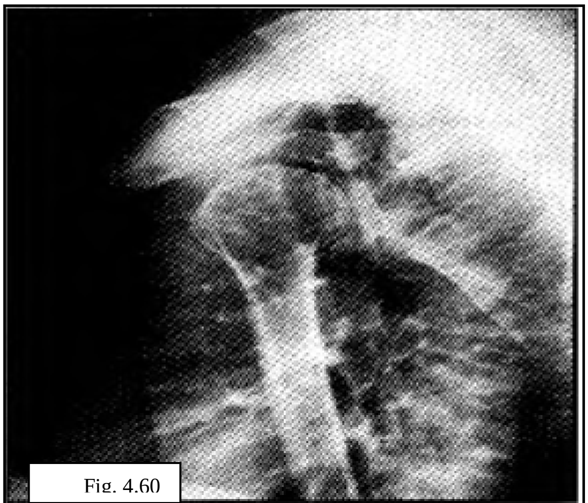


Fig. 4.60

Radiographs (7): Additional projections (2): *Normal translateral (1)*: If the patient is not able to have the arm abducted, a translateral is another view that may be used to give additional information. Unfortunately detail is often poor, especially in the stout patient. (Some prefer an apical oblique projection, taken with the plate at 45° and the beam angled appropriately; this duplicates and foreshortens the features seen in Frame 4.48, but helps clarify the glenohumeral relationship.)

Chapter 5
The elbow

The elbow is a hinge joint . it is a relatively stable joint , with firm osseous support. it composed of three articulations : *(fig. 1)*

1) The humeroulnar joint.
2) The humeroradial joint.
3) The radioulnar joint.

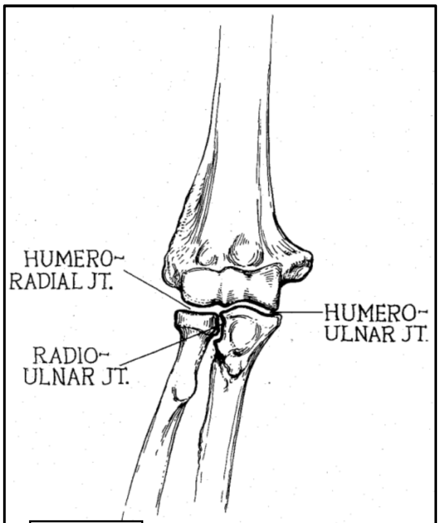


Fig. 5.1 he three elbow articulations.

Examination of the elbow will include these articulations and the soft tissues surrounding them.

- Expose the patient to the waist.
- Examine the patient on standing position (setting or lying if necessary).
- Examine the patient according to the system :

  Look, feel – measure, move, stress, power, sensation, reflexes, distal pulse, special test, x-ray.

Inspection (look):

❖ ***The attitude :***

- Carrying Angle

When the arm is extended in the anatomic position (palms facing anteriorly), the longitudinal axis of the upper arm and forearm form a lateral (valgus) angle at the elbow joint known as the *" **Carrying Angle**"*

Valgus, meaning " *away from the midline* " or " *lateral* “, is easily remembered if the " ***L***" in va***L***gus is associated with the "***L***" in lateral. *(Fig. 2)*

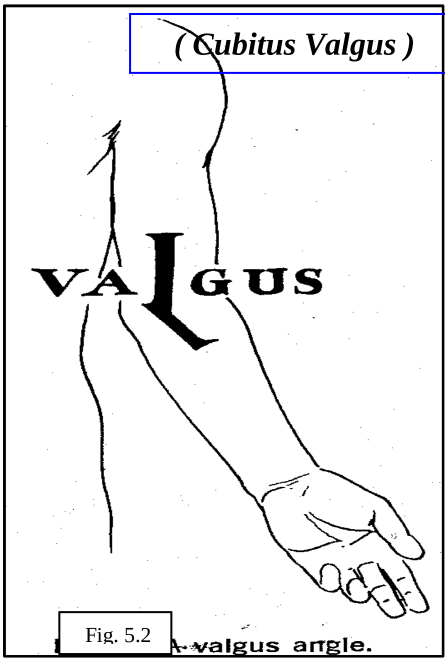


Fig. 5.2

A normal carrying angle measures approximately 5^{o} in male and between 10^{o} and 15^{o} in female.
The carrying angle allows the elbow to fit closely into the depression at the waist, immediately superior to the iliac crest. The angulation is particulary noticeable when the hand is carrying something heavy. *(Fig. 3)*

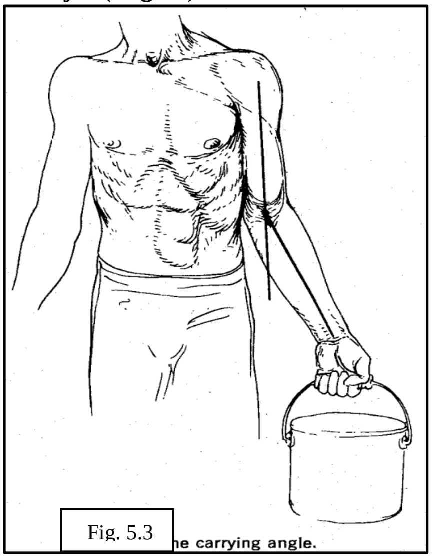


Fig. 5.3

If the angle increased we call this position a Cubitus Valgus deformity, if it decreased a Cubitus Varus or a gunstock deformity. *(Fig. 4)*

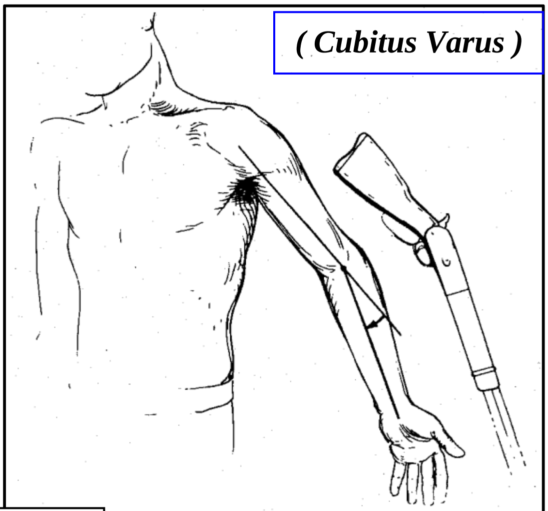


Fig. 5.4 "gunstock" deformity (varus angulation).

Look for:

- Generalized swelling of the joint.
-Muscle wasting.
-The swollen elbow is always held in the semi-flexed position.
- Note the earliest sign of effusion is the filling out of the hollows seen in the flexed elbow above the olecranon.
- Note if there are any localized swellings round the joint – e.g. :
(A) Olecranon bursitis, (B) Rheumatoid nodules. *(Fig. 5)*

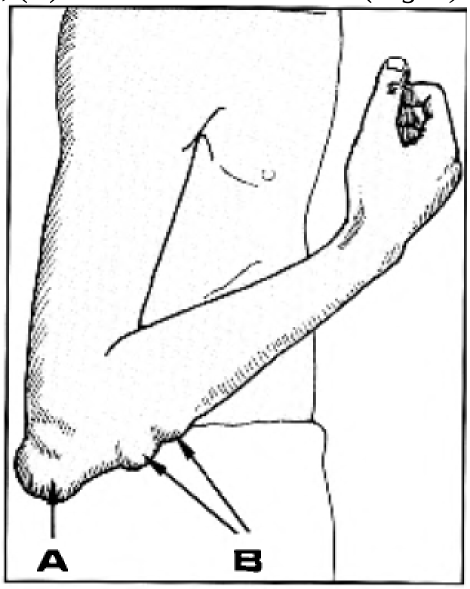


Fig. 5.5 **ection (3):** Note whether there are any localized swellings round the joint, e.g. (A) olecranon bursitis, (B) rheumatoid nodules.

Look to the skin for any changes – scars, sinus, change colour....ect.

Palpation :

Soft tissue, start palpation as the following order: medial aspect, posterior aspect, lateral aspect and anterior aspect.

❖ ***The Ulnar Nerve:***

The ulnar nerve is situated in the sulcus (groove) between the medial epicondyle and the olecranon process, and can be palpated as it rolled gently under the index and middle fingers *(Fig. 6)*.

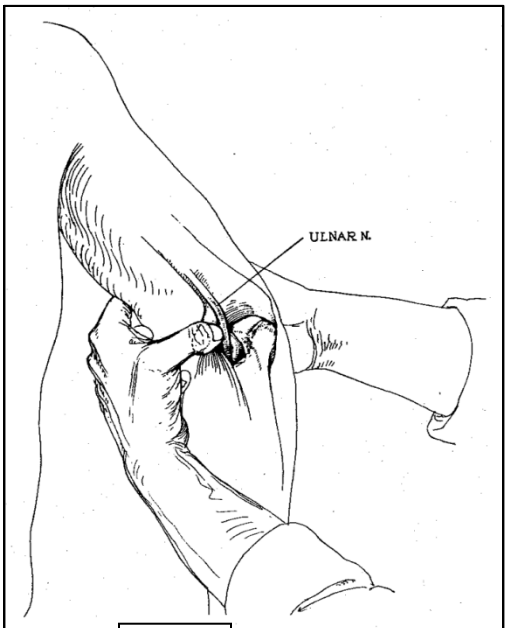


Fig. 5.6 he ulnar nerve.

❖ ***Wrist flexor – pronator muscle group:*** This group is composed of four muscles:

1- The pronator teres
2- The flexo – carpi radialis
3- The palmris longus.
4- The flexo – carpi ulnaris.

These muscles originate from the medical epicondyle as a common tendon. The muscle mass and origin may become tender if they are strained by activities requiring wrist flexion pronotion (tennis, golf, using screwdriver) – "*The golfer's elbow*".
We can easily remember their order and pattern if you place your hand over your forearm with your thenar eminence upon the medial epicondyle.
With your finger spread down the foream , your thumb represents the pronator teres, your index finger the flexor carpi radialis, your middle finger the Palmaris longus, and your ring finger the flexor carpi ulnaris. *(fig. 7)*

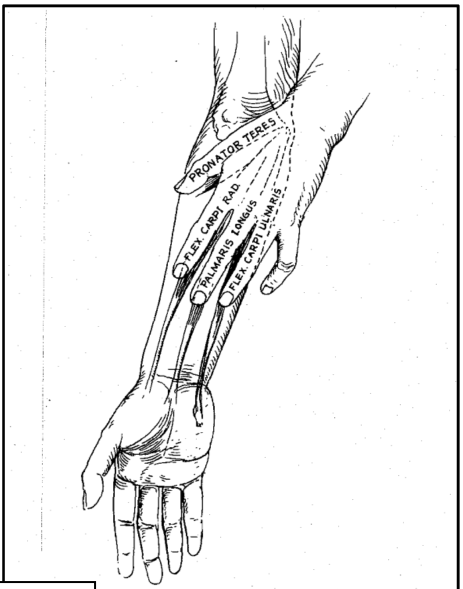


Fig. 5.7 he wrist flexor–pronators (Redrawn from Henry, AK: Extensile Exposure, 2nd ed. London, Churchill Livingston, 1957).

- ❖ ***The supracondylar lymph nodes:*** Palpate them above and anterior to the medial epicondyle.
- ❖ ***Olecranon Bursa:*** The Olecranon Bursa covers the Olecranon and is not distinctly palpable. However, the area in which it lies should be palpated. If the bursa is inflamed (bursitis) or inspissate (thickened), the area will feel boggy and thick.

- As you palpate this area, explore along the posterior ulnar border and check for rheumatoid nodules, which are occasionally found in this region.

- ❖ ***The triceps aponeurosis***, which expands distally, is broad and thin and palpable only to the proximal end of the olecranon process. its course should be checked for any tenderness or defects secondary to trauma.

- ❖ ***Wrist extensors:*** The wrist extensors originate from the lateral epicondyle and its supracondylar line.

This group is composed of three muscles :

1) The brachioradialis.
2) The extensor carpi radials longus.
3) The extensor carpi radials brevius.

The muscle mass and origin may become tender if they are strained by activities requiring wrist extension- supination (tennis, using screwdriver… etc.) -*“The tennis elbow”*.

- ❖ ***The cubital fossa:*** The cubital fossa is a triangular space, bordered laterally by the brachioradialis and medially by the pronator teres.

The foss's base is defined by an imaginary line drawn between the two epicondyles of the humerus from its lateral to medial borders, the structures passing through the cubital fossa are:

1) The biceps tendon to the radial tubercle.
2) The brachial artery.
3) The median nerve.

- ❖ ***Biceps tendon:*** If the patient to flexes his elbow against resistance; the biceps tendon will stant out and can be easily palpable.
- ❖ ***Brachial artery:*** The pulse of the brachial artery can be felt directly medial to the biceps tendon.
- ❖ ***Median never:*** The median never is a round tubular structure lying directly medial to the brachial artery.

❖ ***Musculocutaneous nerve:*** The nerve is not palpable, but for clinical purposes it is located under the brachioradialis approximately one or two inches above the line of the elbow joint. It supplies the coraco-brachialis and biceps and provides sensation for the forearm.

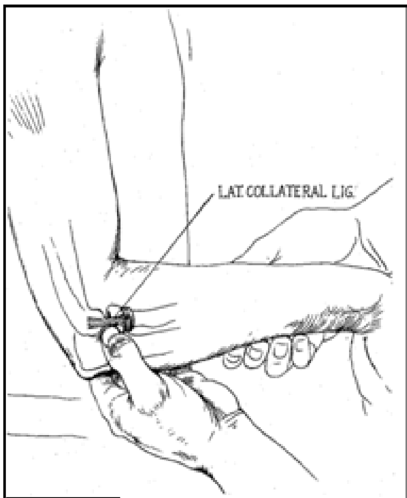


Fig. 5.8 The annular ligament.

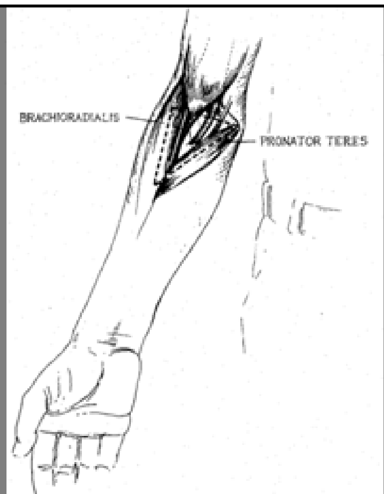


Fig. 5.9 The cubital fossa.

Fig. 5.10 The biceps tendon.

Fig. 5.11 The brachial artery.

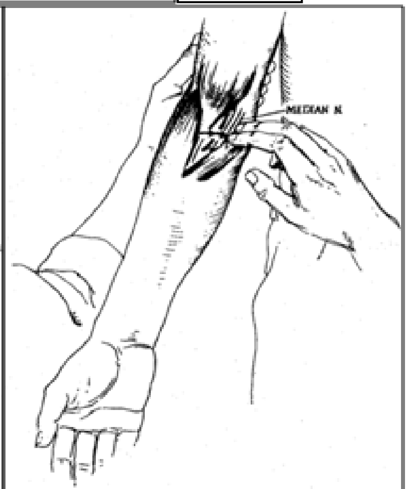


Fig. 5.12 The median nerve.

Range of motion:

The patient may stand or sit during the active range of motion tests, while the examiner is either at his side or directly in front of him.

- ***Active test:***
  - ***Flexion = 135°***

    Instruct the patient to bend his elbow and try to touch the front of his shoulder. Normally he is able to touch his shoulder.

  - ***Extension = 0° – 5°***

Extension limits are defined by the point at which the olecranon strikes the olecranon fossa.
Ask the patient to straighten his elbow as for as he can. Most males can achieve the normal 0^o Extension. Females are normally able to extend the arm to a minimum of 0^o and many are able to hyperextend the elbow as much as 5^o beyond the straight position.

- ***Supination = 90^o***

The limits of Supination are defined by the degree to which the radius can rotated around the ulna. To test the active Supination, instruct the patient to flex his elbow to 90^o and then to hold the flexed elbow into his waist. This positioning will prevent him from substituting shoulder adduction and internal rotation for forearm supination.
For testing supination ask the patient to hold a pencil in each hand, and then to move both forearms simultaneously into supination. In normal supination the pencils are parallel to the floor. Any asymmetry in their positions indicates restricted supination.

- ***Pronation= 90^o***

The patient maintains the same position as in supination, with elbows flexed and at his waist, and fists holding the pencils. Ask the patient to rotate his fist from a fully supinated position until his palm faces downward. In normal pronation, the palm will face the floor, and the pencils, having turned 180^o from the position of supination, will again be parallel to the floor. Any dissimilarity in the position of the pencils implies a restricted range of pronation.
Supination and pronation should be performed as one test, since the two motions essentially describe a single arc of motion.

- ***Passive test:***

If there is any limitation or in complete range of motion we should perform the same motions of flexion, extension, supination and pronation passively, (by the examiner).

Neurosurgical examination:

We should examine the following:
1- power of the flexors, Extensor, supinators and pronators.
2- Reflexes of the upper limb. (Biceps reflex C_5, Brachioradialis C_6, and Triceps C_7)
3- sensation of the upper limb. (P.NO ???)

Special tests:

Test for ligamentous stability.
This test is employed to assess the stability of the medial and lateral collateral ligaments of the elbow.
To conduct this test, cup the posterior aspect of the patient's elbow in one hand and hold his wrist with the other. Your hand on the elbow will act as a fulcrum around which your other hand will force the forearm during the test.
First , instruct the patient to flex his elbow a few degrees as you force his forearm laterally, producing a valgus stress on the joint's medial side.

Notice if there is any gapping on the medial side underneath your hand. Then reverse direction and push the forearm medially, producing a varus stress to the elbow's lateral side.
Again, inspect for any gapping on the lateral side.
Your hand , in its position on the elbow, acts not only as a stabilizer and a fulcrum but as a means for palpating the collateral ligament during the test. *(fig. 13)*

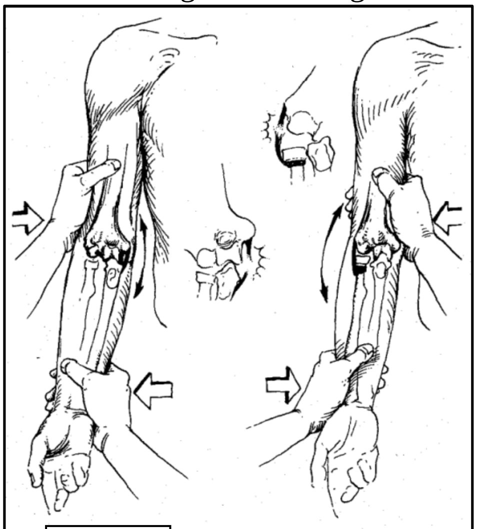


Fig. 5.13 st for ligamentous stability.

❖ ***Tennis elbow test:***

This test is designed to reproduce the pain of tennis elbow. Stabilize the patient's forearm and instruct him to make a fist and to extend his wrist. When he has done so apply pressure with your other hand to the dorsum of his first in an attempt to force his wrist into flexion. If he has tennis elbow, the patient will experience a sudden severe pain at the site of the wrist extensors' common origin; the lateral epicondyle. *(Fig. 14)*

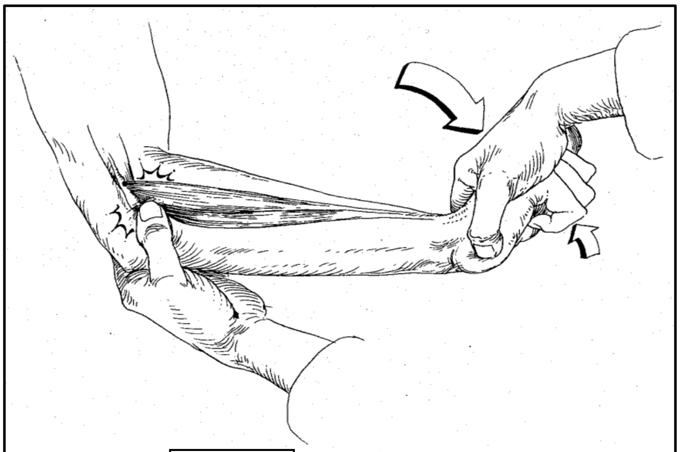


Fig. 5.14 he tennis elbow test.

❖ ***Tinel's sign:***

Is a test designed to elicit tenderness over a neuroma with a nerve. If there neuroma with the ulnar nerve, taping the area of the nerve in the groove between the olecranon and the medial epicondyle will send a tingling sensation down the forearm to the ulnar distribution in the hand.

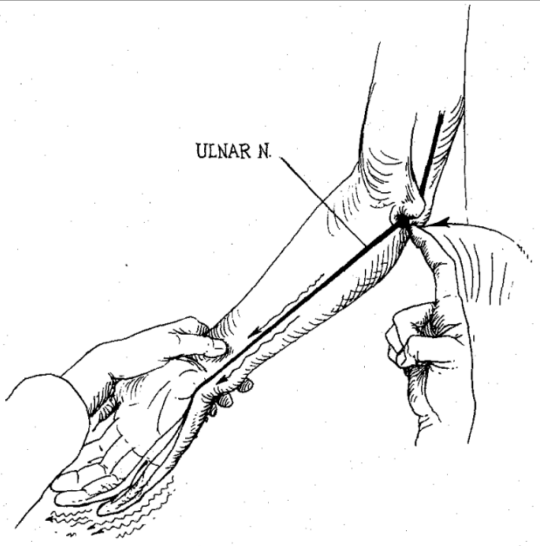


Fig. 5.15 The Tinel sign.

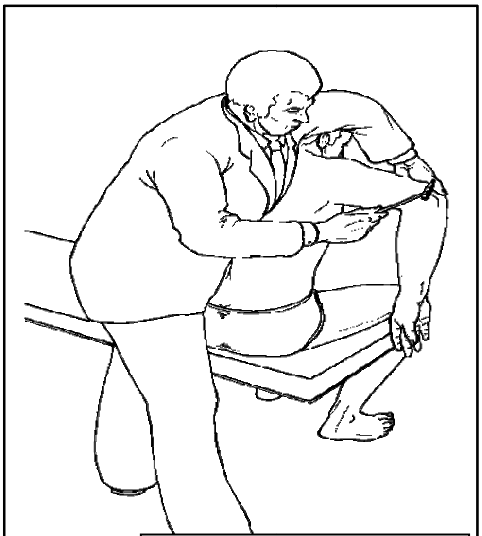


Fig. 5.16 The Tinel test.

- ❖ ***Chair test:*** *(Fig. 16)*
  - Indicates lateral epicondylitis. *(Tennis elbow)*
  - ***Procedure:*** The patient is requested to lift a chair. The arm should be extended with the forearm pronated.
    - While holding the elbow in full extension,
    - pronating the forearm, and dorsiflexing the wrist,
    - the patient lifts the back of a chair.
  - ***Assessment:*** Occurrence of or increase in pain over the lateral epicondyle and in the extensor tendon origins in the forearm indicates epicondylitis.
    - ➢ The test elicits apprehension in patients with lateral epicondylitis.

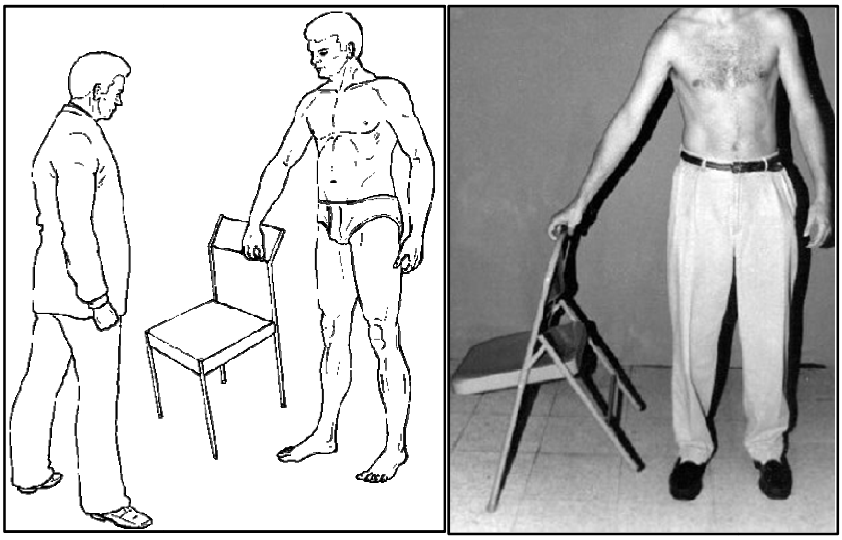


Fig. 5.17 Chair Test

- ❖ ***Test for golfer's elbow:*** *(Fig. 17)*

Flex the elbow, supinate the hand, and then extend the elbow. Pain over the medial epicondyle is very suggestive of golfer's elbow.

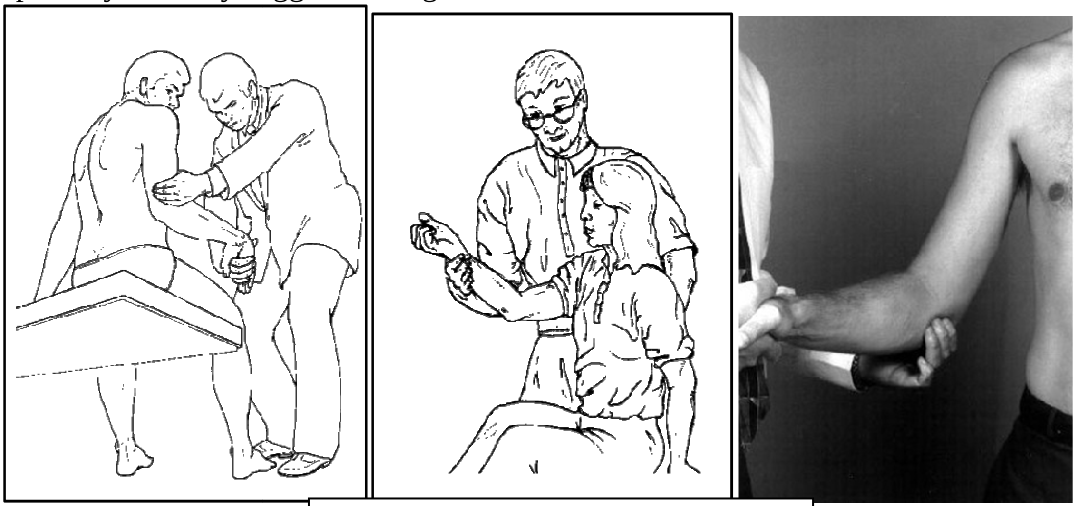


Fig. 5.18 Tests For Golfer's Elbow

- Please examine the related areas : The cervical spine, the shoulder and the wrist. Sometimes a pain may referred from these areas to the elbow.

The elbow

❖ ***Plain X-Ray:***

(1) The position of each bone is noted, then the joint line and space.
(2) The individual bones are inspected for evidence of old injury or bone destruction.
(3) There may be some calcification over the epicondyles in cases of tennis or golfer's elbow.
(4) Loose bodies are sought.

- In children the epiphyses are largely cartilaginous and the articular relations often have to be deduced from the shape and the position of the emerging secondary ossific centres.
- The average ages at which they appear are easily remembered by the mnemonic ***CRITOE*** :

  Capitulum → 2 years.
  Radial head → 4 years.
  Internal (Medial) epicondyle → 6 years.
  Trochlea → 8 years.
  Olecranon → 10 years.
  External (Lateral) epicondyle → 12 years.

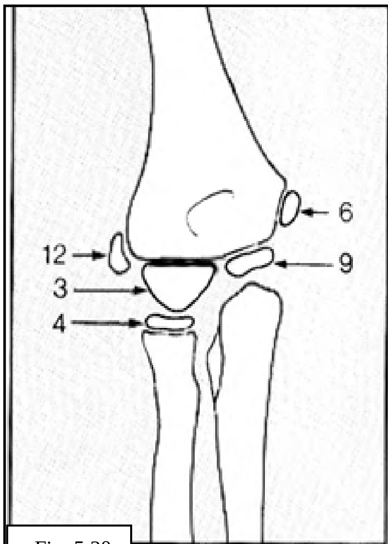


Fig. 5.20

Radiographs (9): Interpretation of radiographs of the elbow in children is made difficult by the changes produced by the successive appearance of ossification in the epiphyses (and there are both gender and race variations). The old mnemonic 'cite' (capitulum, *i*nternal epicondyle, *t*rochlea, *e*xternal epicondyle) for the appearance of the epiphyseal centres at 3, 6, 9 and 12 years, is sufficiently accurate for normal purposes.

Fig. 5.21

Radiographs (8): Normal anteroposterior radiograph of the elbow of a child of 8.

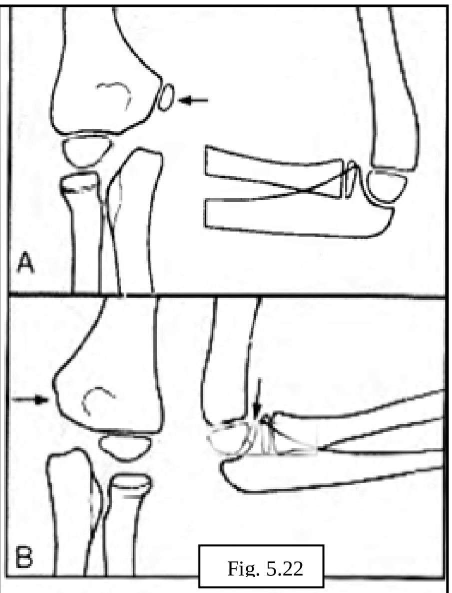


Fig. 5.22

Radiographs (10): If there is any doubt, radiographs of both sides should be taken. Note that if a child over the age of 6 has injured the elbow there is every likelihood that the medial epicondyle has become displaced into the joint if it *cannot* be seen in the anteroposterior view, or if it *can* be seen in the lateral. (A) Normal, (B) displaced.

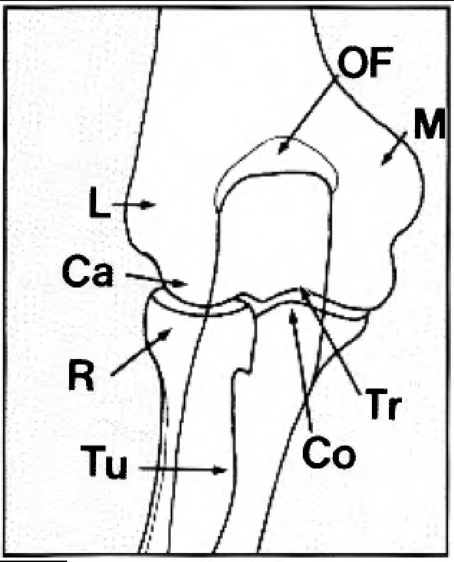


Fig. 5.23 **Radiographs (2):** In examining the standard AP view trace out the outline of (M), the medial epicondyle; (OF) the olecranon and coronoid fossae; (L) the lateral epicondyle; (Ca) the capitulum; (R) the radial head; (Tu) the tuberosity of the radius; (Co) the coronoid process of ulna; (Tr) the trochlea.

Fig. 5.24 **Radiographs (1):** Normal anteroposterior radiograph of the elbow.

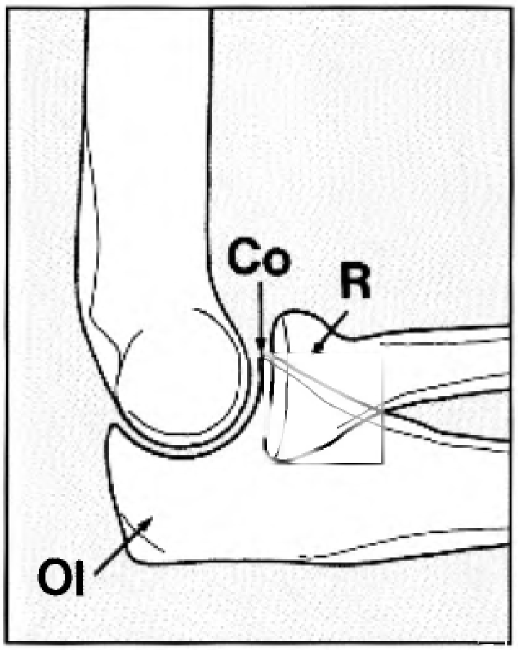


Fig. 5.25 **Radiographs (4):** In examining the standard lateral projection, note (R) the radial head; (Co) the coronoid process of the ulna; (Ol) the olecranon.

Fig. 5.26 **Radiographs (3):** Normal lateral radiograph of the elbow.

What is the Baumann's angle?

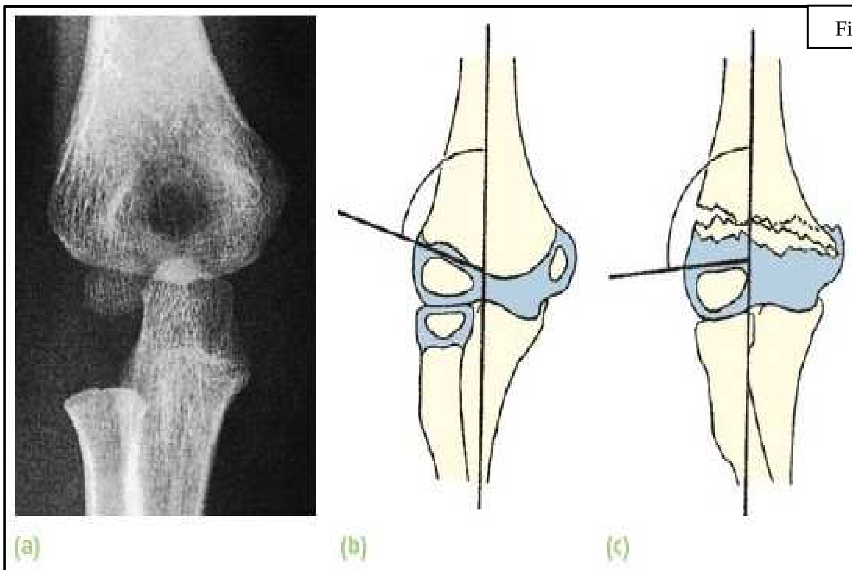


Fig. 5.27 **Baumann's angle**
Anteroposterior x-rays are sometimes difficult to make out, especially if the elbow is held flexed after reduction of the supracondylar fracture. Measurement of Baumann's angle is helpful. This is the angle subtended by the longitudinal axis of the humeral shaft and a line through the coronal axis of the capitellar physis, as shown in (a) the x-ray of a normal elbow and the accompanying diagram (b). Normally this angle is less than 80 degrees. If the distal fragment is tilted in varus, the increased angle is readily detected (c).

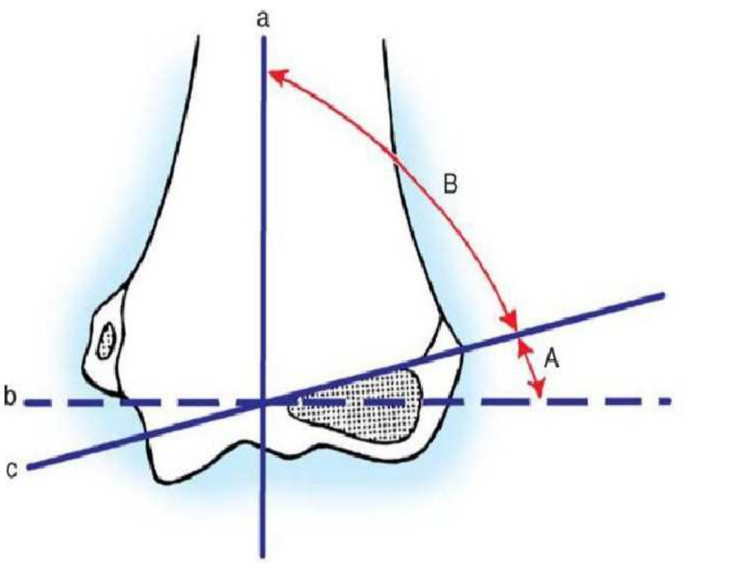


Fig. 5.28 umann angle. a, Midline diaphysis of humeral shaft. b, Line perpendicular to midline. c, Line through physis of lateral condyle. Angle A is original Baumann angle. Angle B is more commonly used currently.

What is the metaphyseal-diaphyseal angle?

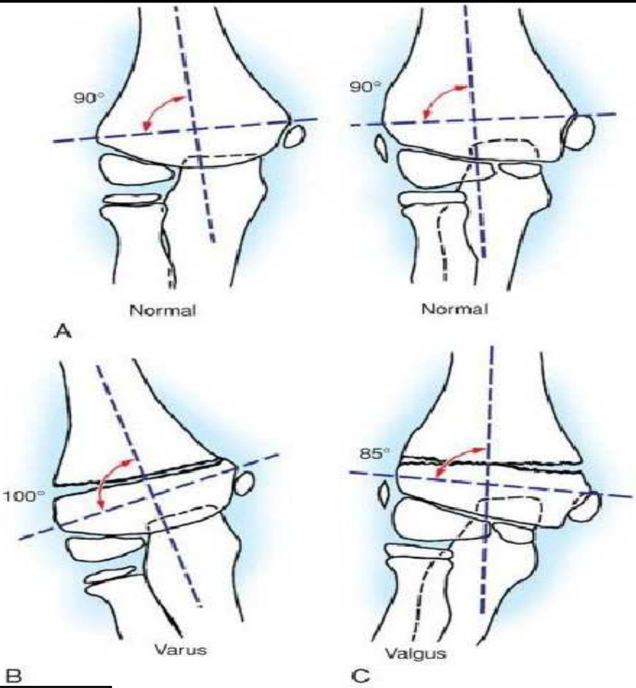


Fig. 5.29 Metaphyseal-diaphyseal angle. On anteroposterior radiograph, transverse line is drawn through metaphysis at its widest point, and longitudinal line is drawn through axis of diaphysis; angle is measured between lateral portion of metaphyseal line and proximal portion of diaphyseal line. **A,** Normal angle is 90 degrees. **B,** Angle greater than 90 degrees indicates varus angulation. **C,** Angle less than 90 degrees indicates valgus angulation.

Chapter 6
The wrist

- Examine the wrist by the same system of look, feel, measure, move – power, sensation, reflexe, distal pulse and special tests.
- Bilateral comparison is a fast way to discover the presence of pathological signs.

Inspection: from front:

- Note any deformity of the wrist, e.g:
  - Radial deviation of the hand (mal-united Colles' fracture, congenital absence of the radius) .
  - Ulnae deviation (Rheumatoid arthritis).
- Thenar wasting (median nerve injury?)
- Hypothenar wasting (ulnar never injury ?)
- Scars suggestive of previous surgery or injury.
- Note any localized swellings suggestive of ganglion , rheumatoid nodule , ,or tumor.
- Note the presence of muscle wasting in the forearm which indicate chronicity of the process (rheumatoid arthritis , tuberculosis) or neurological disorder (cervical spine injury , multiple sclerosis or muscular dystrophy).

Inspection: from the side :

- Note any undue prominence of the ulna (mal-united Colles’ fracture , Madelung deformity).
- Anterior tilting of the plane of the wrist (mal-united smith's fracture)
- Backward tilting (mal-united Colles’ fracture)
- Anterior subluxation (rheumatoid arthritis, old carpal injury or infective arthirtis).
- Swelling over the lateral aspect of the distal radius occurs in De-Quarvain's tenosynovitis.

Inspection: from dorsum :

- Ganglions on the wrist may be quite obvious on inspection.
- Swelling of the wrist , hand and fingers , with a glazed a appearance of the skin ,diffuse tenderness, pain and stiffness is typical of Sudeck's atrophy which may occur as a sequel to Colles’ fracture or carpal injury.

Palpation:

- Tenderness on inferior radio-rulnar joint is always a present after a Colles’ fracture.
- Tenderness in the anatomical snuff box (scaphoid fracture ?) .
  - to help distinguish a sprain from fracture palpate the dorsal surface of the scaphoid . Tenderness here is usually present a after fractures but not sprains.
- Diffuse Tenderness is common in all inflammatory lesions (rheumatoid arthritis and tuberculosis of the wrist) and in Sudeck's atrophy .
- Tenderness localized to the sheaths of abductor pollicis longus and extensor pollicis brevis is found in De-Quarvains tenosynovitis . The sheath its self is thick.
- Tenderness over the median , with the production of paraesthesiae in the fingers and lateral side of the hand is suggestive of the carol tunnel syndrome.
- Tenderness with paraesthesia on pressure over the ulnar nerve is suggestive of the ulnar tunnel syndrome.

Movement:

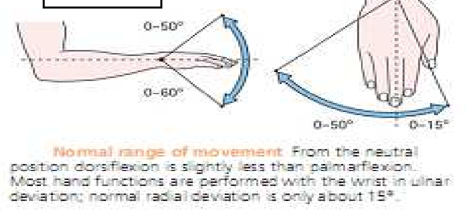
- The Movement pertaining to with function are :
  1) Flexion
  2) Extension
  3) Radial deviation
  4) Ulnar deviation
  5) Supination (of the forearm).
  6) Pronation (of the forearm).

Fig. 6.1

Active Range of motion:

- Bilateral comparison is most useful in determining the degrees of restriction in any given situation .
- A patient should be able to complete the quick active tests without any strain or symptoms of pain. If however he has any difficulty or is unable to complete the active range of motion satisfactory, passive range of motion testes should be conducted.
  - *Palmer flexion* = 75°

Fig. 6.2



  - *Dorsiflexion (Extension)* =75°
- Wrist ulnar and radial deviation:
  Ask the patient to move his wrist from side to side into ulnar and radial deviation.
  - *Ulnar deviation* = 35°
  - *Radial deviation* =20°
- *Supination* and *pronation* (given in elbow examination).

Neurological examination :

- Examine the reflexes and sensation of the upper limb.
- Examine the power of the muscles.

Wrist extension:

- To test wrist extension , stabilize the patient’s forearm by placing your palm on the dorsum of his wrist and wrapping your fingers around it .
- When it is fully extended , place the palm of your resisting hand upon the dorsum of his hand , and try to force his wrist out of its extended position.
    - Normally it is not possible to move the patient's wrist out of position .
- The opposite side should be tested for comparison , and your findings should be evaluated in accordance with the muscle grading chart.

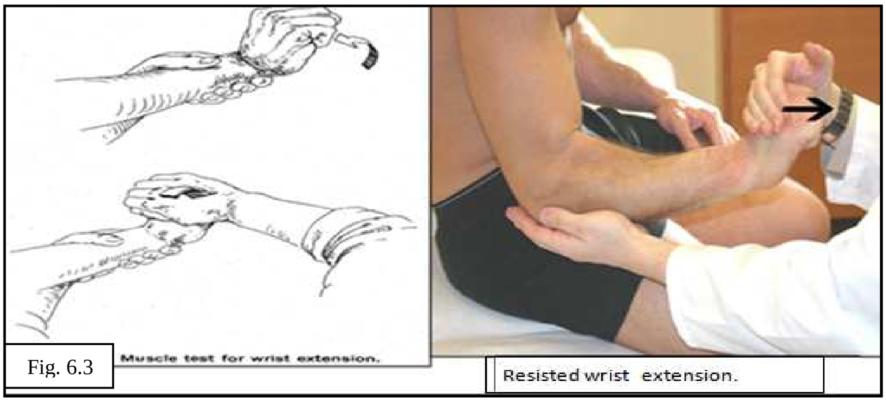


Fig. 6.3 Muscle test for wrist extension. Resisted wrist extension.

Wrist flexion :

- To test Wrist flexion, instruct the patient to make a fist since , in some instances , the fingers flexors can act as wrist flexors.
- By having the patient make a fist , you eliminate the finger flexors as active factors in wrist flexion.
- Then stabilize the wrist and ask the patient to flex his closed fist at the wrist.
- When the wrist is in flexion , place your resisting hand over the patient's flexed fingers , and try to pull the wrist out of flexion.

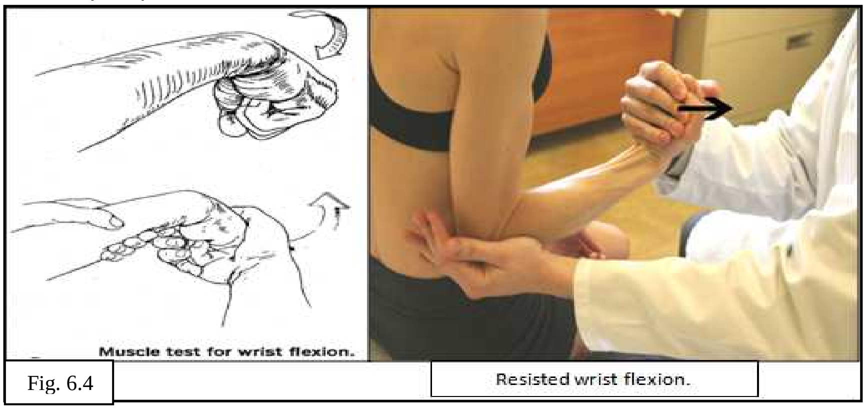


Fig. 6.4 Muscle test for wrist flexion. Resisted wrist flexion.

Wrist supination and pronation: …(see the elbow).

Examination of the radial and ulnar arteries:

Radial pulse:

- Flex the wrist and touch the tips of his thumb and little fingers together in opposition.
- The Palmaris longus tendon becomes prominent along the midline of the anterior aspect of the wrist.
- Lateral (radial) to it the flexor carpi radialis also becomes prominent.
- Lateral to the flexor carpi radialis on the anterior aspect of the styloid process of the radius you can now palpate the radial pulse.

Ulnar artery:

- The pulse of ulnar artery is palpable proximal to the pisiform bone just before the artery cross the wrist on the anterior aspect of the ulna.
- The pulse can be felt if you press the artery against the ulna.

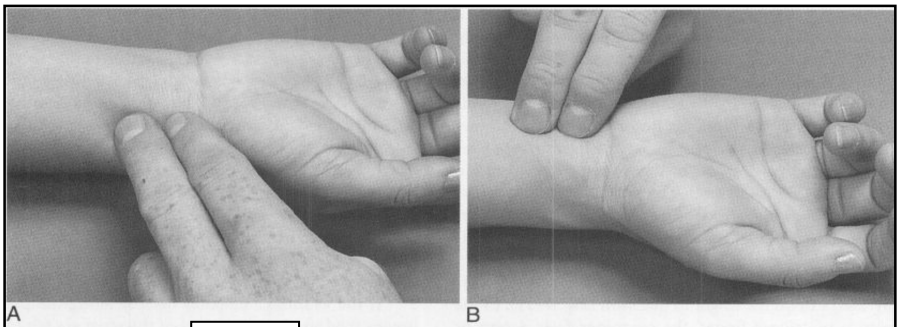


Fig. 6.5 *A,* Palpation of the radial artery. *B,* Palpation of the ulnar artery.

Special test:

1) Finkelstein's test: *(for De-Quarvain's disease)* (see Fig 3)

- The examiner places the patient's thumb across the palm in full flexion, and then, holding the patient's hand firmaly, turns the wrist sharply into adduction.
- In a positive test; this is acutely painful; repeating the movement with the thumb left free is relatively painless.

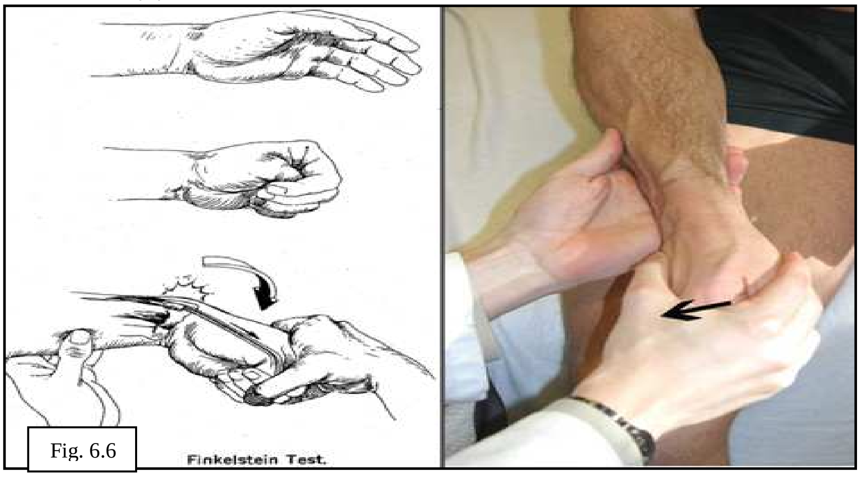


Fig. 6.6

2) Tinel sign: *(for carpal tunnel syndrome)* (see Fig 4)
To confirm a diagnosis of carpal tunnel syndrome, you can elicit or reproduce pain in the distribution of the median nerve by tapping over the volar carpal ligament.

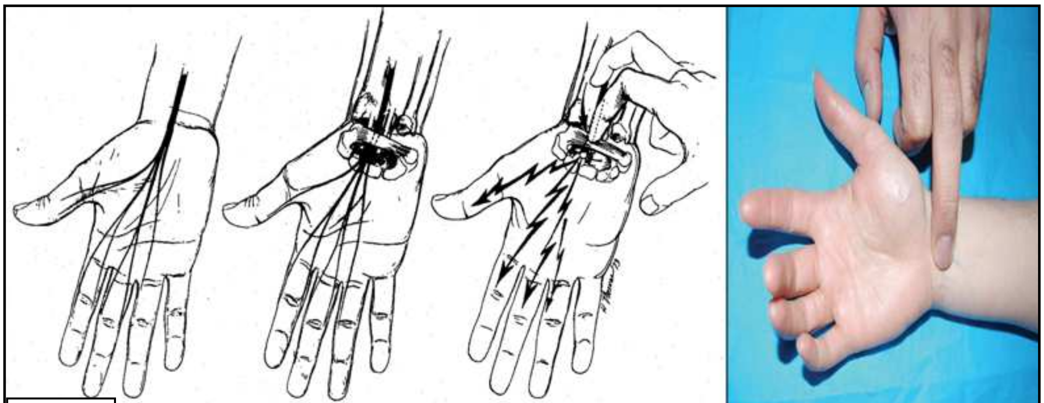


Fig. 6.7 Carpal Tunnel Syndrome (left and middle). Tinel sign (right).

3) Phalen's test: *(for carpal tunnel syndrome)* (see Fig 5)
Symptoms common to the syndrome such as tingling of the fingers may also be reproduced by flexing the patient' wrist to its maximum degree and holding it in that position for at least a minute. (or by pressing the flexed wrist opposite each other).

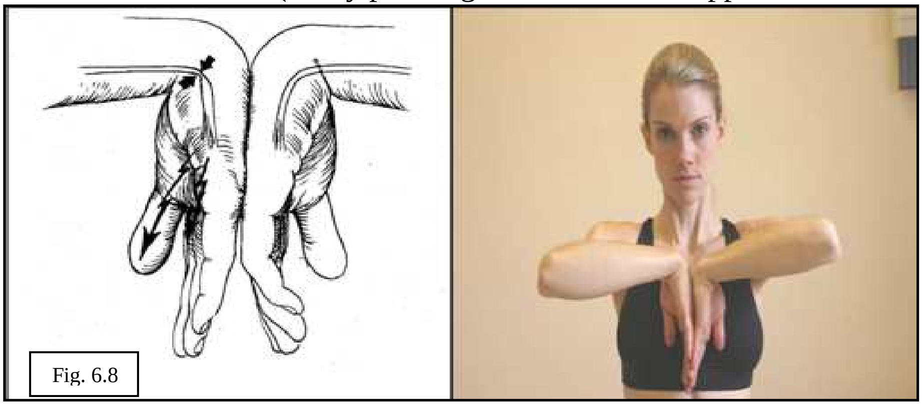


Fig. 6.8

- ***Note:***
  - An alternative test for carpal tunnel syndrome is by applying applying a sphegeneomonemeter cuff and inflate it to just above the systolic blood pressure for 1-2 minutes. The appearance or exacerbation of symptoms again suggests the carpal tunnel syndrome.
  - If there is still doubt , apply a scaphoid plaster for 7- 10 days. Improvement of symptoms while in plaster, and deterioration on removal is suggestive of the carpal tunnel syndrome.

4) Allen test: (see Fig. 6 and Fig. 7)

- This test makes it possible to determine whether or not the radial and ulnar arteries are supplying the hand to their full capacities.
- To perform the test , instruct the patients to open and close his fist quickly several times, and then to squeeze his fist tightly so that the venous blood is forced out of the palm.
- Place your thumb over the radial artery and your index and middle fingers over the ulnar artery , and press them against the underlying bones to occlude them.

- With the vessels still occluded instruct the patient to open his hand. The plam of the hand should be pale. Then release one of the arteries at the wrist, while maintaining the pressure upon the other one.
    - Normally, the hand flushes immediately.
- If it does not react or if it flushes very slowly the released artery is partially or completely occluded.
- The other artery should be tested similarly, and the opposite hand checked for comparison.

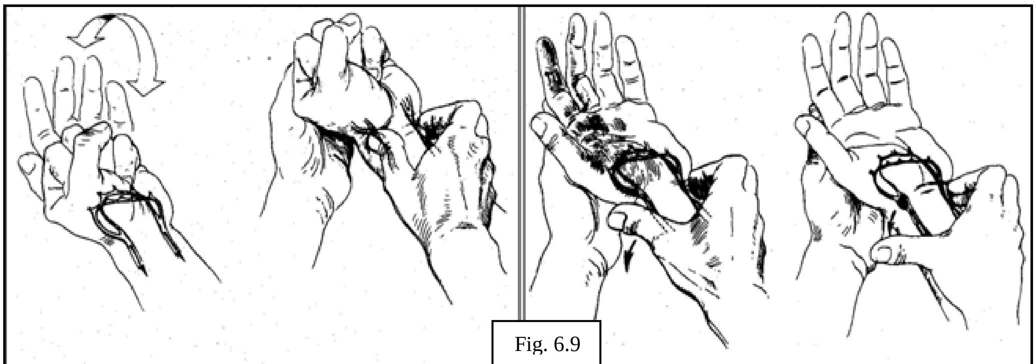
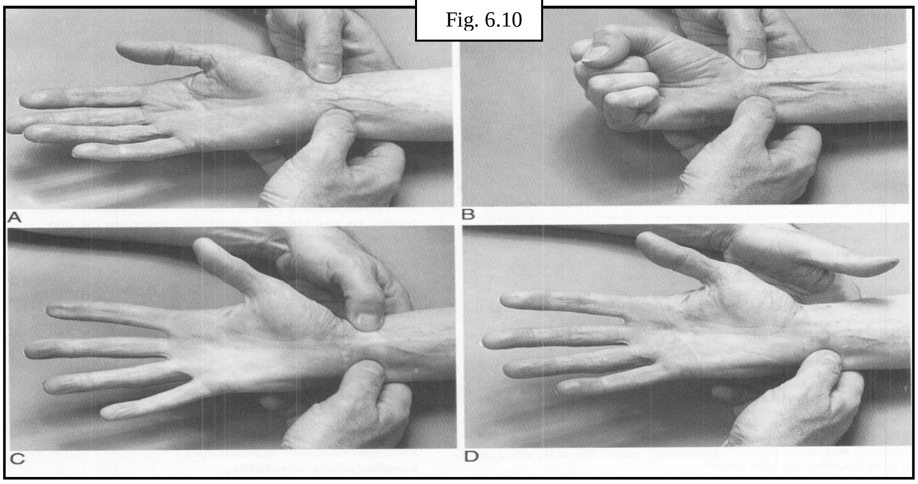


Fig. 6.9

. The Allen test evaluates blood supply to the hand. **Left.** The patient first opens and closes his fist several times. **Right.** With the patient's fist closed, pressure is applied to the radial and ulnar arteries to occlude them.

. **Left.** When the patient opens his hand, pressure is released from one of the arteries, and the hand should flush immediately. **Right.** If the hand does not flush or reacts slowly, the artery is either completely or partially occluded.

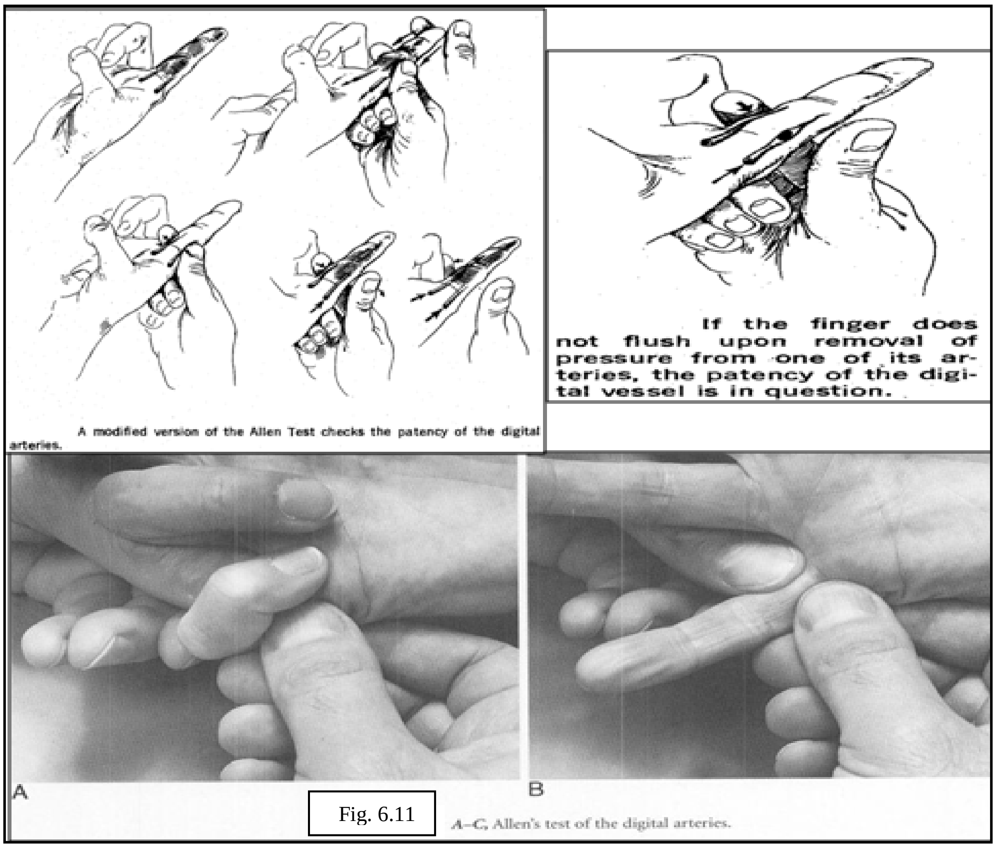
Fig. 6.10



5) *Modified Allen test:* (see Fig. 8 and Fig. 9)

- This test used for evaluation of the patency of the digital arteries.
- Instruct the patient to open and close his fist quickly, several times, and then to hold it tightly closed to forced the venous blood from the palmer aspect of the fingers.
- With the hand still in the fist, place your thumb and index finger on the sides of the base of the involved finger, pressing them to the bone to occlude the digital arteries.
- When the patient opens his hand, the test finger should be paler than the others.
    - The finger normally flushes when pressure is released from one of the arteries.
- If it does not, the patency of that digital vessel is in question.
- The other digital artery should be tested in the same way and the corresponding finger on the opposite hand checked for comparison.

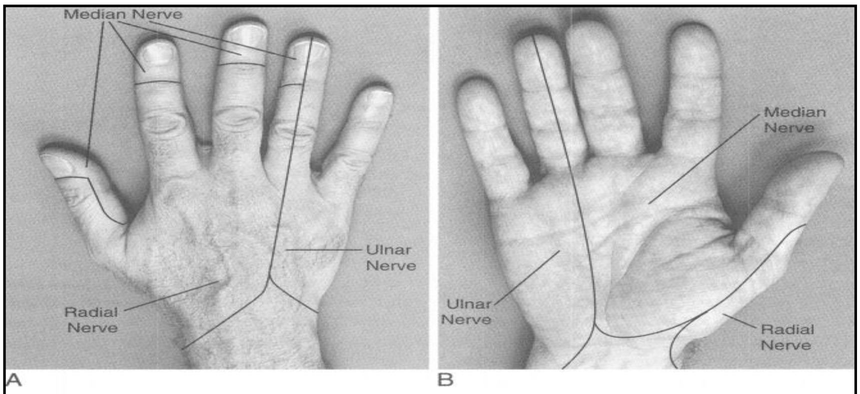
Note: please examine the related areas.
Symptoms can be reffered to the wrist and hand from the elbow , shoulder and the cervical spine.



A modified version of the Allen Test checks the patency of the digital arteries.

If the finger does not flush upon removal of pressure from one of its arteries, the patency of the digital vessel is in question.

Fig. 6.11 *A–C,* Allen's test of the digital arteries.

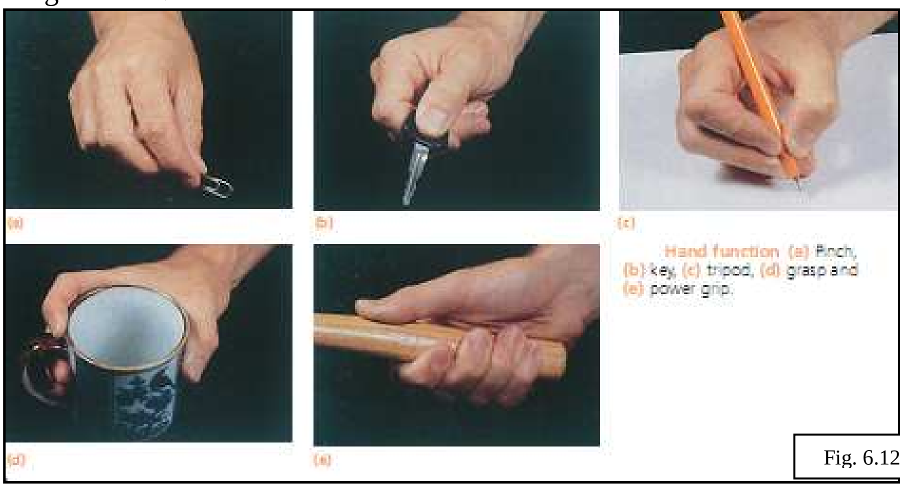


Average sensory distribution in the hand. *A,* Dorsum. *B,* Palm.

The Hand

Inspection:

- Initially , observe the patient's hands in function to ascertain if they are being used easily and spontaneously, rather than being guarded or protected.
- When the patient first enters the room, notice whether or not his upper extremities move normally and symmetrically, for pathology of the hand occasionally affects the swinging motion of the upper extremity.
- In most instances, a patient holds an injured hand splinted across his chest on positioned stiffly at his side.
- Because of the possibility of symptom referral from other areas of the body, examination of the hand requires that the entire upper extremity be exposed, including the cervical spine.
- Therefore, *ask the patient to undress to the waist*, and observe his hand movements as he does so.
- normal hand motion appears smooth and natural with the fingers moving in a synchronous manner, while abnormal movements looks stiff or jerky.
- occasionally, altered shoulder or elbow movements can compensate for pathology in the hand.
- After observing the hands in function, appraise their overall structure, it may seen grossly elementary, but it is important that the fingers be counted to make certain that there are the necessary five on each hand. The loss of a finger is not always evident at a glance. If, for example, one finger has been amputated and another surgically moved into the gap.
- It is particularly important to count the fingers of the newborn, since a congenital absence or excess of digits is sometimes less than obvious.
- The attitude of the hand is another factor to be considered in inspection. At rest , both the metacarpophalangeal and the interphalangeal joints normally hold a position of slight flexion, with the fingers lining up almost parallel to each other.
- If one finger, in comparsion to the others, is extended, its tendon may have been damaged or cut.



Hand function (a) Pinch, (b) key, (c) tripod, (d) grasp and (e) power grip.

Fig. 6.12

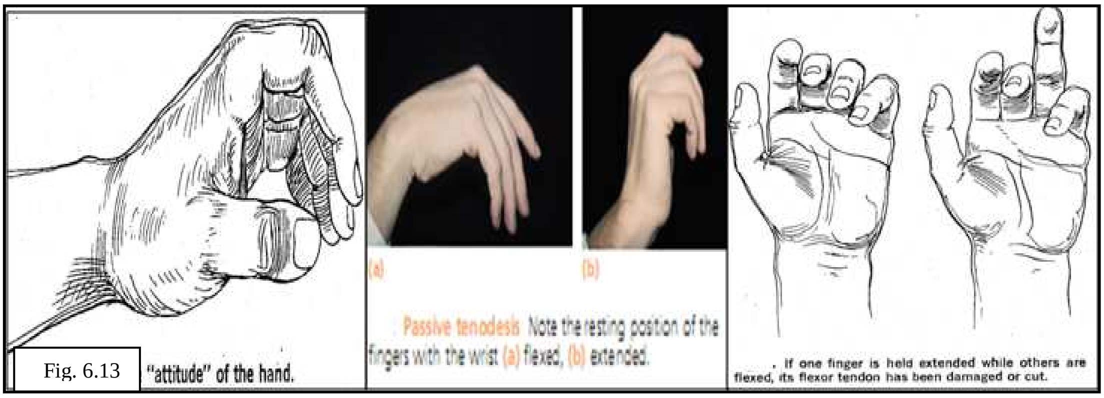
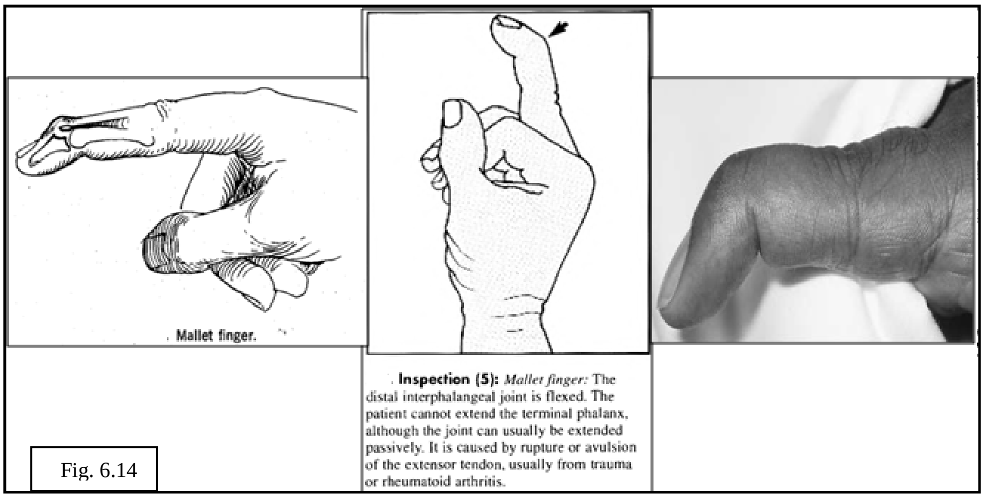


Fig. 6.13 "attitude" of the hand.

(a) (b) Passive tenodesis Note the resting position of the fingers with the wrist (a) flexed, (b) extended.

If one finger is held extended while others are flexed, its flexor tendon has been damaged or cut.

- Look at the general shape of the hand and its size in proportion to the rest of the patient; e.g.:
  - The fingers are short and stumpy in achondroplasia.
  - The hand is large and coarse in acromegaly.
  - In myxoedema, the hand is often podgy and the skin dry.
  - In Marfan's syndrome the proximal phalanges in particular are long and thin.
  - In Turner's syndrome the ring metacarpal is often very short.
  - In hyperparathyroidism the finger tips may be short and bulbous,
  - While in Down's and Hurler's syndromes the little fingers are incurved.
- Note the presence of any hypertrophy of a finger. This may occur in Paget's disease, neurofibromatosis and local arterio-venous fistula.
- Note the presence of any fusiform swelling of the proximal interphalangeal joint. The commonest causes are collateral ligament tears and rheumatoid arthritis. Less commonly it is seen in syphilis, T.B, sarcoidosis and gout. In psoriatic arthritis the distal joint is usually involved.
- ***Mallet finger:*** the distal interphalangeal joint is flexed. The patient cannot extend the terminal phalanx, although the joint can usually be extend passively. It is caused by rupture or avulsion of the extensor tendon, usually from trauma or rheumatoid arthritis.



Mallet finger.

Inspection (5): *Mallet finger:* The distal interphalangeal joint is flexed. The patient cannot extend the terminal phalanx, although the joint can usually be extended passively. It is caused by rupture or avulsion of the extensor tendon, usually from trauma or rheumatoid arthritis.

Fig. 6.14

- ***Mallet thumb:*** loss of active extension the interphalangeal joint of the thumb is due to rupture of extensor pollicis longus. This is seen as a late complication of colles' fracture, from rheumatoid arthritis or wounds of the wrist or the thumb with tendon division.

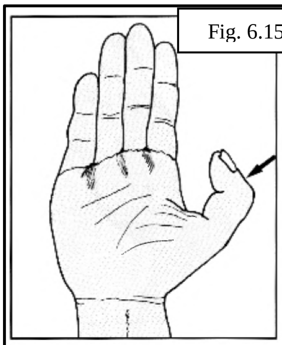
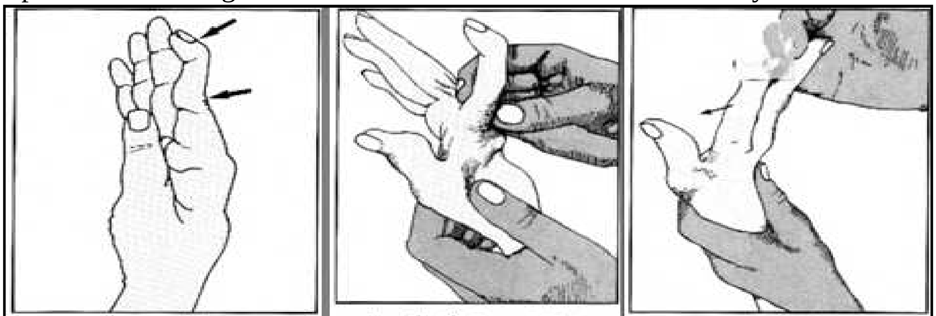


Fig. 6.15

7.6. Inspection (6): *Mallet thumb:* Loss of active extension in the interphalangeal joint of the thumb is due to rupture of extensor pollicis longus. This is seen as a late complication of Colles' fracture, from rheumatoid arthritis, or wounds of the wrist or the thumb with tendon division.

- ***Swan- neck deformity:*** the distal interphalangeal joint is flexed and the proximal interphalangeal joint is hyperextended. It is seen most often in rheumatoid arthritis, and may be produced by a number of different factors. Extend the metacarpo-phalangeal joint of the affected finger. Improvement in the deformity indicate that shortening of extensor digitorum communis is a factor. If the deformity is made worse, tight interossei are likely to be responsible. Hold all the fingers in an extended position, but leave the affected finger free. Ask the patient to flex it. If he cannot, this indicates rupture of flexor digitorum sublimis as the cause of the deformity.



Inspection (7): *Swan-neck deformity (1):* The distal interphalangeal joint is flexed and the proximal interphalangeal joint hyperextended. It is seen most often in rheumatoid arthritis, and may be produced by a number of different factors.

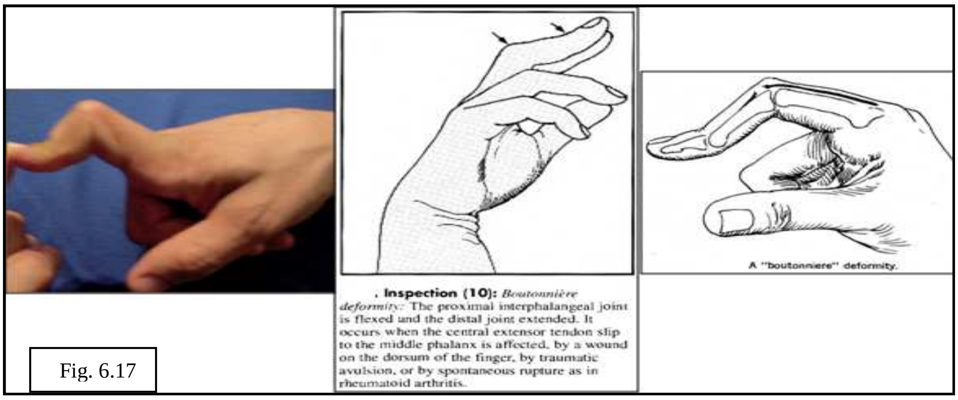
Inspection (8): *Swan-neck deformity (2):* Extend the metacarpophalangeal joint of the affected finger. Improvement in the deformity indicates that shortening of extensor digitorum communis is a factor. If the deformity is made worse, tight interossei are likely to be responsible.

Inspection (9): *Swan-neck deformity (3):* Hold all the fingers in an extended position but leave the affected finger free. Ask the patient to flex it. If he cannot, this indicates a rupture of flexor digitorum sublimis as the cause of the deformity.

Swan-neck deformity.

Fig. 6.16

- ***Boutonniere deformity:*** The proximal interphalangeal joint is flexed and the distal joint extended. It occurs when the centeral extensor tendon slip to the middle phalanx is affected, by a wound on the dorsum of the finger, by traumatic avulsion, or rupture in rheumatoid arthritis.



. **Inspection (10):** *Boutonnière deformity:* The proximal interphalangeal joint is flexed and the distal joint extended. It occurs when the central extensor tendon slip to the middle phalanx is affected, by a wound on the dorsum of the finger, by traumatic avulsion, or by spontaneous rupture as in rheumatoid arthritis.

Fig. 6.17

- ***Z-deformity of the thumb:*** The thumb is flexed at the metacarpo- phalangeal joint and hyperextended at the interphalangeal joint. The deformity is seen in rheumatoid arthritis secondary to displacement of the extensor tendons or rupture of flexor pollicis longus.

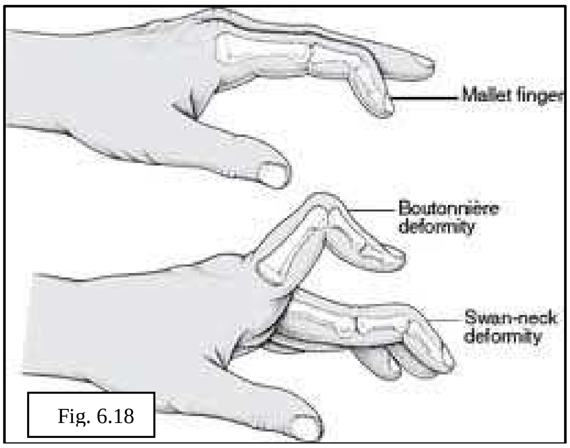


Fig. 6.18

- Flexion of a finger at the metacarpo-phalangeal joint, with inability to extend, follows rupture or division of the extensor tendon in the back of the hand or at the wrist.
- Flexion of the little finger, mainly at the proximal interphalangeal joint, is seen in congenital contracture of the little finguer.
- Flexion of the fingers at the metacarpo-phalangeal and interphalangeal joints, associated with nodular thickening in the palm and fingers, is characteristic of Dupuytren's contracture. The thumb is occasionally involved.
- Flexion of the middle or ring fingers, at the proximal interphalangeal joint, with sudden extension on effort or with assistance, is seen in trigger finger. There is usually a palpable nodular thickening over the corresponding metacarpo-phalangeal joint .
- Flexion of the interphalangeal joint of the thumb in infants and young children is usually due to stenosing teno-vagnitis involving flexor pollicis longus. A nodular thickening is usually palpable over the metacarpo-phalangeal joint.

- In volkmann's lschaemic contracture (which usually occurs as a sequel to brachial artery damage in a supracondylar fracture) there is clawing of the thumb and fingers and forearm wasting. The fingers can be extended if the wrist is flexed.
- Ischaemic contracture of the small muscles of the hand usually as a result of swelling within a tight forearm plaster, leads to fingers which are flexed at the metacarpo-phalangeal joints and extended at the interphalangeal joint. The thumb is adducted into the palm.

- Ulnar deviation of the fingers at the metacarpo-phalangeal joints occurs in rheumatoid arthritis. In the later stages the metacarpo-phalangeal joints may dislocate.
- Unilateral wasting suggests a root, plexus or never lesion.
  Widespread involvement necessitates a full examination to exclude neuropathy, syringomyelia, multiple sclerosis and the muscular dystrophies.

- ***Look for different hand swellings:***
  Note heberden's nodes on the dorsal surface of the distal interphalangeal joint. (they are often associated with deviation of the distal phalanx and are a sign of osteo-arthritis of the fingers.)

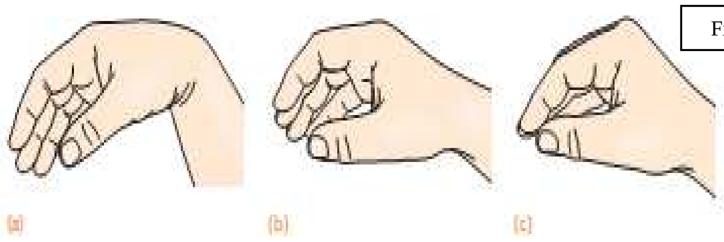


Fig. 6.19

ree positions of the hand (a) The position of relaxation, (b) the position of function (ready for action), (c) the position of safe immobilization, with the ligaments taut.

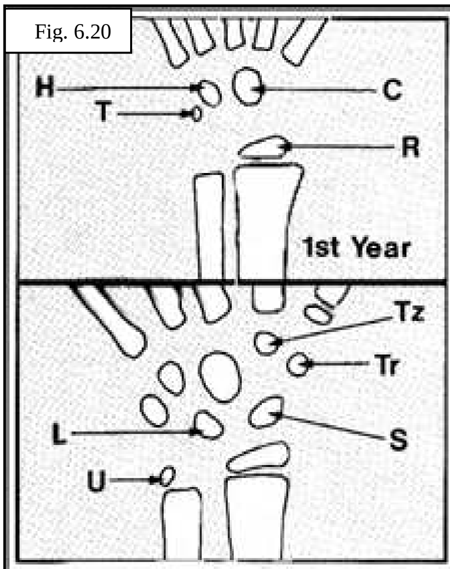
The wrist X-Ray

- Anterior-posterior and lateral views are obtained routinely.

(1) Note the position and the shape of the individual carpal bones and whether there are any abnormal spaces between them.
(2) Look for evidence of joint space narrowing, especially at the radio-carpal joint and the carpo-metacarpal joint of the thumb.

- The wrist x-ray should be taken in standard position of mid-pronation with the elbow at 90 degrees.
- Often both wrists must be x-rayed for comparison.
- Special views may be necessary to show a scaphoid fracture or carpal instability.
- Request cards should be clearly marked “Scaphoid” and not “wrist”.
- When the scaphoid is examined radiologically, two views are not enough. Four views must be taken at different angles, including oblique views in 45° pronation and 45° supination.

Fig. 6.20

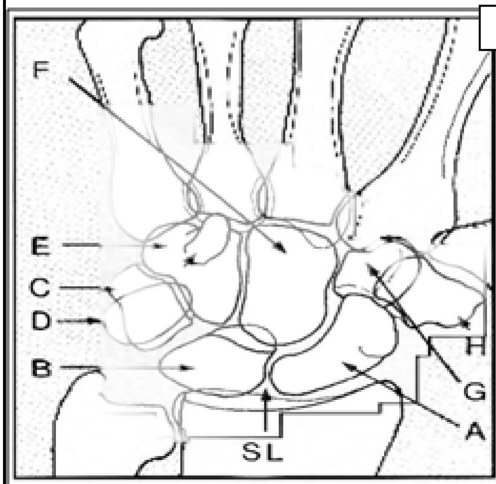


Ossification: In the first year of life the ossification centres for the capitate (C) and hamate (H) appear at 2 months, the radius (R) at 6 months, and the triquetral (T) at 10 months. After the first year, the lunate (L) appears at about 2, the trapezium (Tr) at 2½, the trapezoid (Tz) and scaphoid (S) at 3, and the distal ulna (U) at 4½ years.

Fig. 6.21

X-ray appearance of the normal carpus X-ray of a normal wrist showing the shape and disposition of the eight carpal bones: **(a)** scaphoid; **(b)** lunate; **(c)** triquetrum overlain by pisiform; **(d)** trapezium; **(e)** trapezoid; **(f)** capitate; and **(g)** hamate.

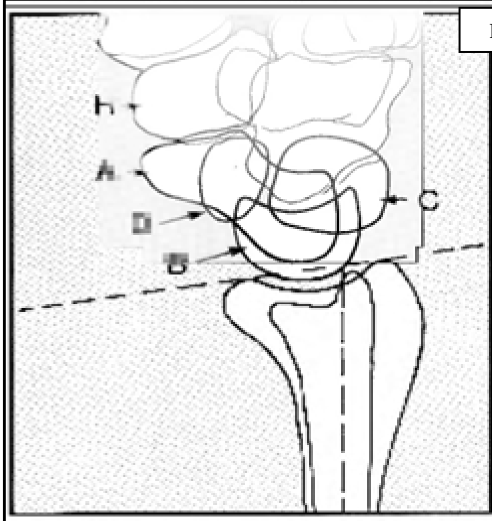
Fig. 6.22



Radiographs (2): *Landmarks:* In the anteroposterior, identify the carpal bones and note their shape, density and position:
(A) scaphoid, (B) lunate, (C) triquetral,
(D) pisiform, (E) hamate with hook,
(F) capitate, (G) trapezoid, (H) trapezium.
Note the gaps between the various carpal bones, particularly between the scaphoid and lunate (SL), and whether these are diminished or excessive.

Radiographs (1): Normal anteroposterior radiograph of the wrist.

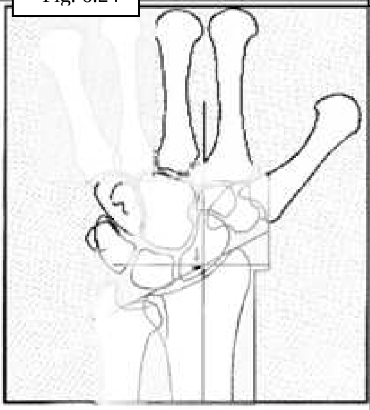
Fig. 6.23



Radiographs (7): It is usually possible to make out in the lateral the following, in spite of the superimposition of the bony structures: (H) trapezium;
(A) tubercle and body of the scaphoid;
(D) pisiform; (B) crescent of lunate;
(C) triquetral. Note that the plane of the wrist joint has normally a 5° anterior tilt.

Radiographs (6): Normal lateral radiograph of the wrist.

Fig. 6.24



.. **Radiographs (4):** Note the *radial inclination*: this is the angle between the distal articular surface of the radius and the radial shaft. It is often decreased after a Colles' fracture. For critical assessment it may be measured on the radiographs.
Normal range = 19–25°.

Fig. 6.25

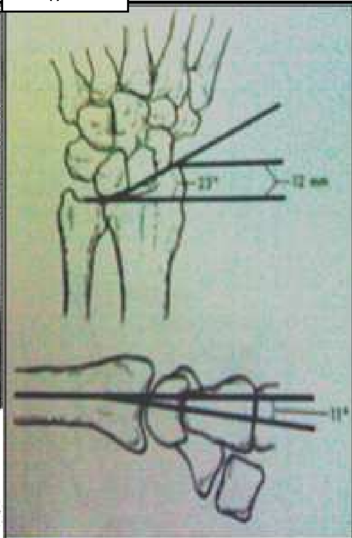


Fig. 49-116 Normal average radial angulation, radial length, and palmar angulation.

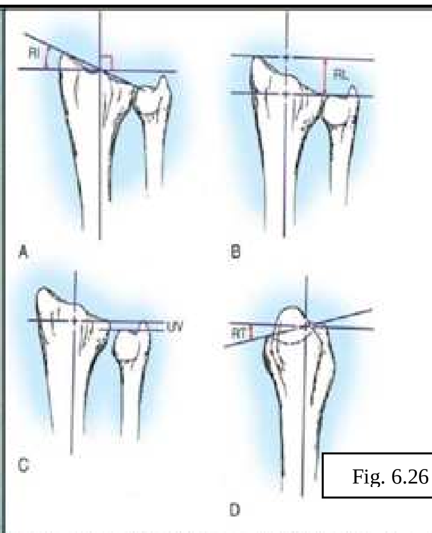


Fig. 6.26

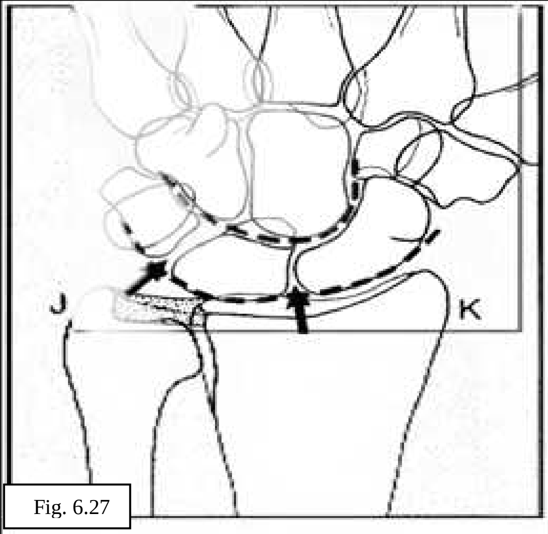
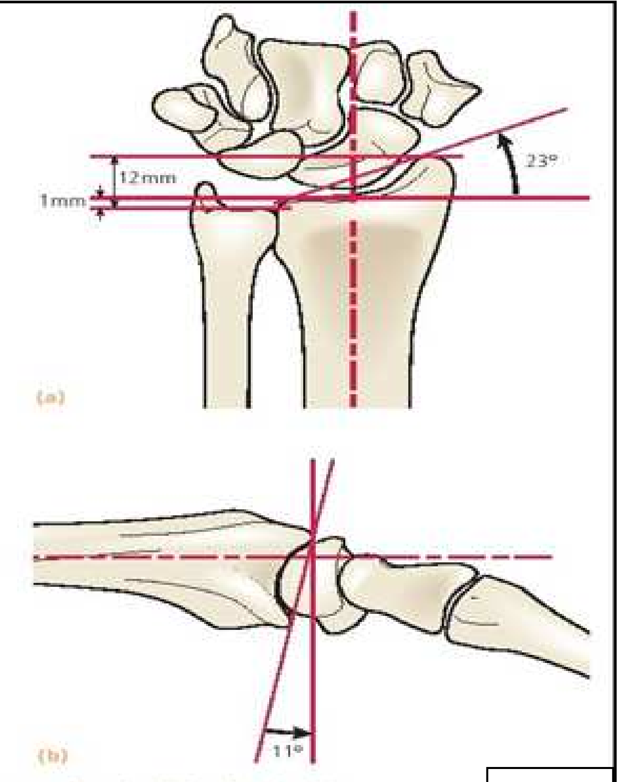


Fig. 6.27

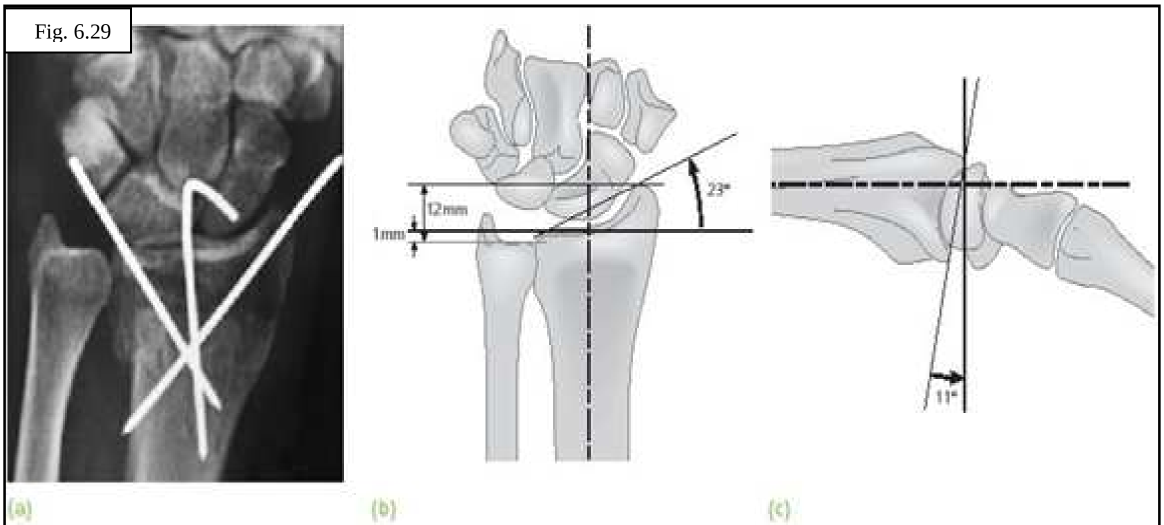
Radiographs (3): Note the smooth curves formed by the proximal and distal rows of the carpus, and that the distal end of the ulna stops short of the radius to make room for the triangular fibrocartilage. If there is any widening of the gaps between the scaphoid and lunate, or the lunate and triquetral, or any suggestion of carpal instability, obtain additional views in full radial and ulnar deviation. (J) Ulnar styloid, (K) radial styloid.



Angle of the distal radius

Fig. 6.28

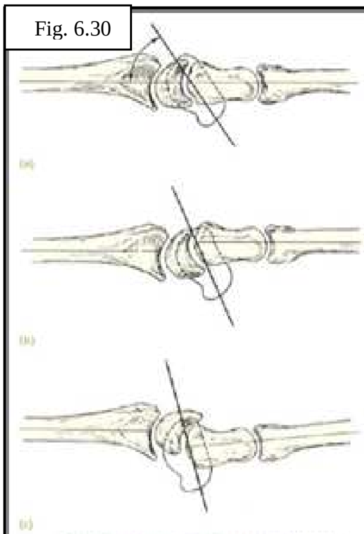
Fig. 6.29



(a) (b) (c)

Colles' fracture – operative fixation (a) Comminuted Colles' fracture reduced and held with percutaneous wires. Make sure that the articular surface angles are correctly restored (b,c).

Fig. 6.30

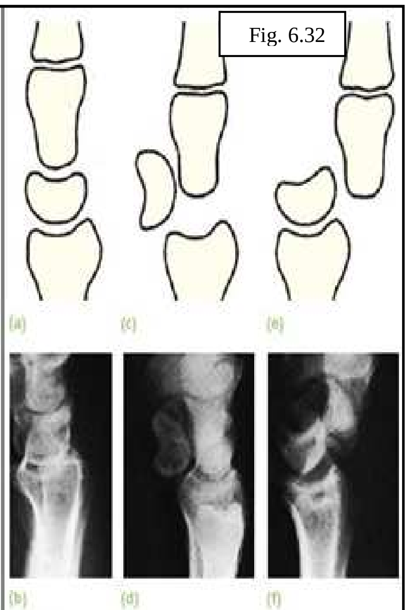


Carpal instability – x-ray patterns (a) Normal lateral view. The radius, capitate and middle metacarpal lie in a straight line and the scaphoid axis is angled at 45° to the line of the radius. (b) Dorsal intercalated segmental instability (DISI). The lunate is tilted dorsally and the scaphoid is tilted somewhat volarwards; the axes of the capitate and metacarpals now lie behind (dorsal to) that of the radius. (c) Volar intercalated segmental instability (VISI). The lunate and scaphoid are tilted somewhat volarwards and the capitate and metacarpals lie anterior (volar) to the radius.

Fig. 6.31

Carpal injuries (a,b) Normal appearances in antero-posterior and lateral x-rays. (c,d) Following a 'sprained wrist' this patient developed persistent pain and weakness. X-rays showed (c) scapho-lunate dissociation and (d) dorsal rotation of the lunate (the typical DISI pattern). (e,f) This patient, too, had a sprained wrist. The anteroposterior and lateral x-rays show foreshortening of the scaphoid and volar rotation of the lunate (VISI).

Fig. 6.32



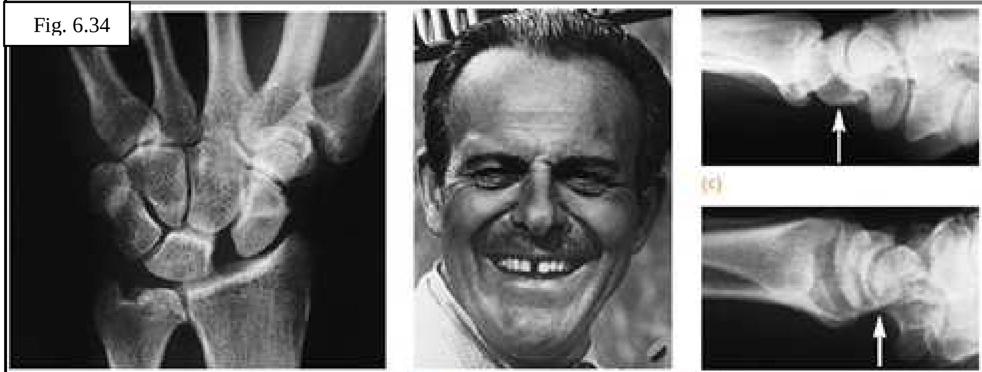
Lunate and perilunate dislocations. (a,b) Lateral x-ray of normal wrist; (c,d) lunate dislocation; (e,f) perilunate dislocation.

Fig. 6.33

(a) (b) (c) (d)

Perilunate dislocation (a,b) Lunate still in its original position while the rest of the carpus is dislocated around it. (c) The dislocation has been reduced and held with K-wires. (d) The luno-triquetral ligament is re-attached with ligament anchors.

Fig. 6.34



(a) (b) (c) (d)

Carpal instability (a) A year after 'straining' his wrist this patient was still complaining of pain; the x-ray shows a gap between the scaphoid and lunate (the *Terry-Thomas sign*) and rotation of the scaphoid. (b) The actor Terry Thomas with the trademark gap between his front teeth (reproduced by permission; © United Artists Inc.). (c) In the lateral view the lunate is tilted dorsally and the scaphoid ventrally (DISI); compare this with (d), an example of VISI, showing volar tilt of the lunate.

Chapter 7
The Neck

Symptoms:

Pain: -In the neck: OA, Trauma, Bone lesion.
-Along the shoulder: Whiplash injury, Disc prolapse.
-Along the upper limbs: Disc prolapse, Cord or root lesion or root irritation (osteophyte).

Stiffness: -Trauma, OA, Rh. arthritis, Ankylosing spondylitis.

Deformity: -Wary neck, Ankylosing spondylitis.

Numbness, tingling and weakness: of the upper limbs or lower limbs (-Root irritation or compression, Cord irritation or compression).

Headache: -If it is associated with other findings it could be from the neck.
-Headache only: look for other causes.

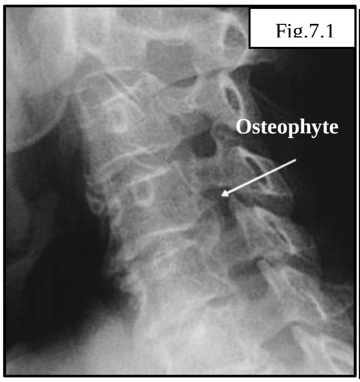


Fig.7.1

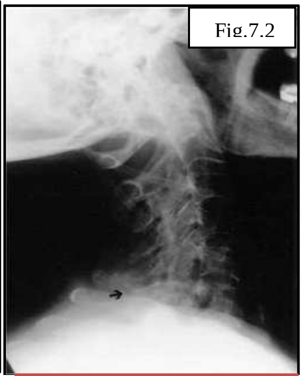


Fig.7.2
Ankylosing spondylitis

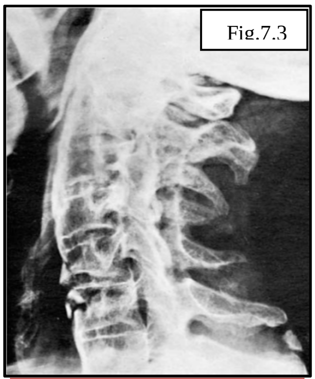


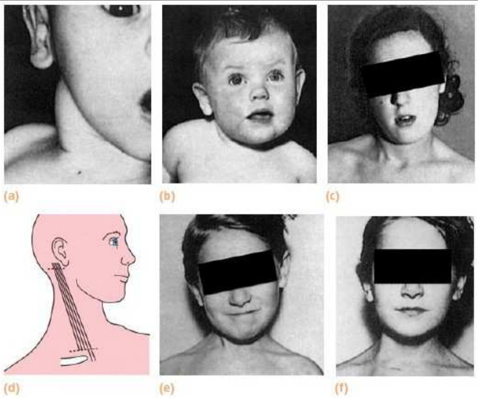
Fig.7.3
Ankylosing spondylitis

Inspection:

- ***Asymmetry in supraclavicular fossa:*** -Pancost tumour.
- ***Torticollis (wary neck):*** Where the head pulled to the affected side, and the chin often tilted to the opposite.

  Causes:-

  1- Congenital: Sternomastoid muscle tumour, Swelling due to fibrosis.
  2- Occular muscle weakness.
  3- Aquired: Due to muscle spasm (Tonsilar or Vertebral body infection).
- **Scoliosis.**
- **Kyphosis.**
- **Oblitration of the normal lordosis / straight spine.**
- **Short neck:** (Fusion of the vertebrae, Klippel-Feil syndrome).
- **Long neck:** Thoracic outlet syndrome/Cervical rib/Madame Zborowska.



Torticollis
(Wary neck)
Fig.7.4

Fig.7.5
Cervical Scoliosis

Fig.7.6
slight cervical scoliosis

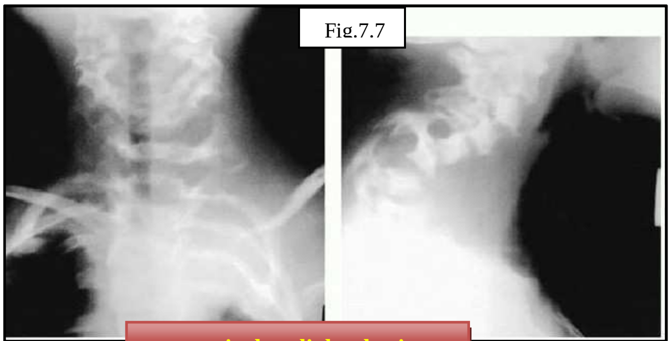


Fig.7.7
cervical scoliokyphosis

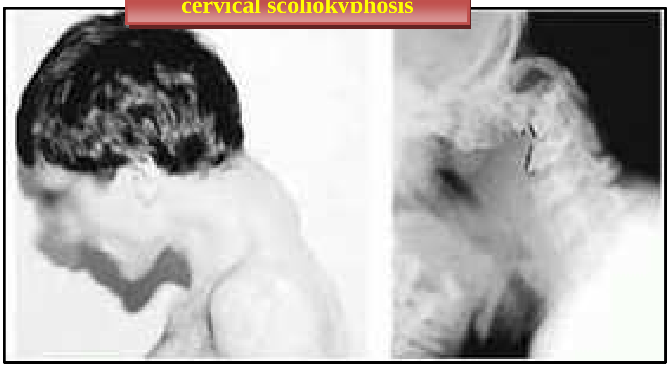


Fig.7.8
Cervical Kyphosis

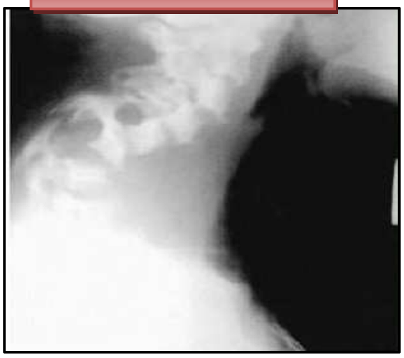
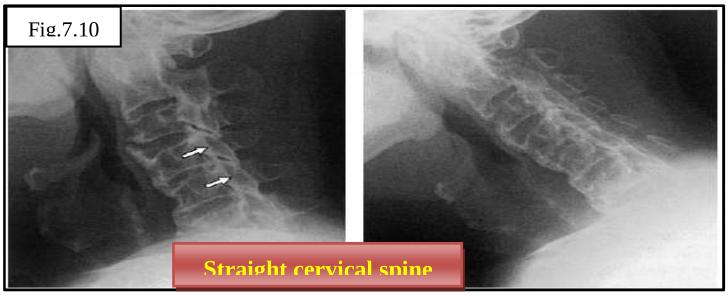


Fig.7.9

Decreased neck lordosis and spastic muscle→Straight cervical

Straight cervical spine

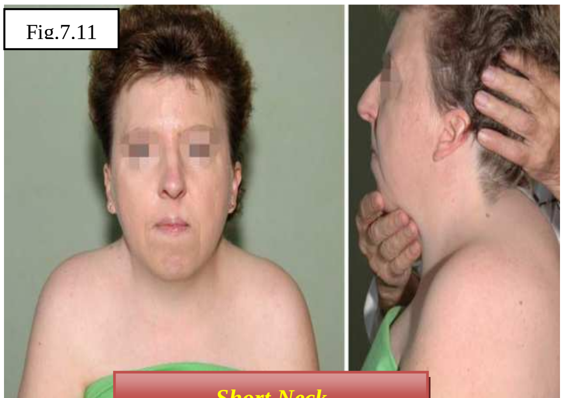
Fig.7.10



Straight cervical spine

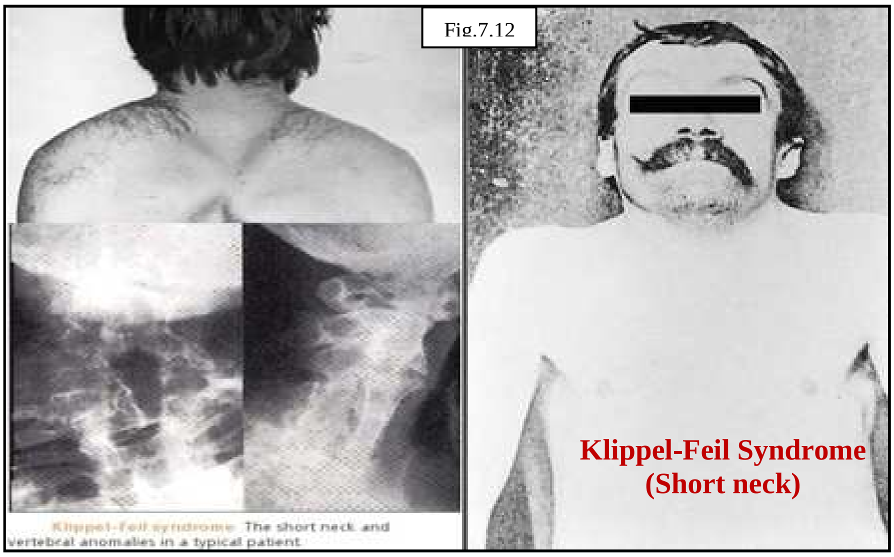
Straight cervical

Fig.7.11



Short Neck

Fig.7.12



Klippel-Feil Syndrome
(Short neck)

Long Neck

(a) (b)

Fig.7.13 Thoracic outlet syndrome (a) Amadeo Modigliani's painting of Madame Zborowska (courtesy of the Tate Gallery, London). (b) X-ray of a long-necked woman: all the vertebrae down to T1 are above the clavicle.

❖ ***Anatomy Of The Root/Base Of Neck (Thoracic Outlet):***

- **Anatomy Of The Thoracic Outlet Syndrome (TOS).**
- **Anatomy Of The Cervical Rib.**

Fig.7.14

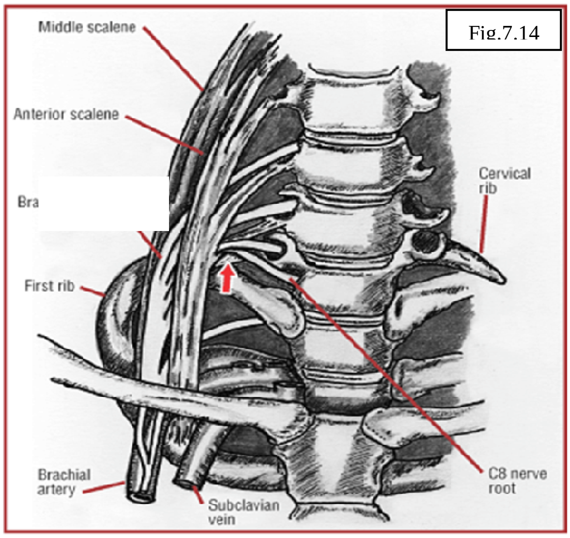


FIGURE 7 Anterior view of the upper chest and neck shows thoracic outlet syndrome caused by an aberrant cervical rib. Note the stretching of the C8 nerve root (arrow) over the cervical rib.

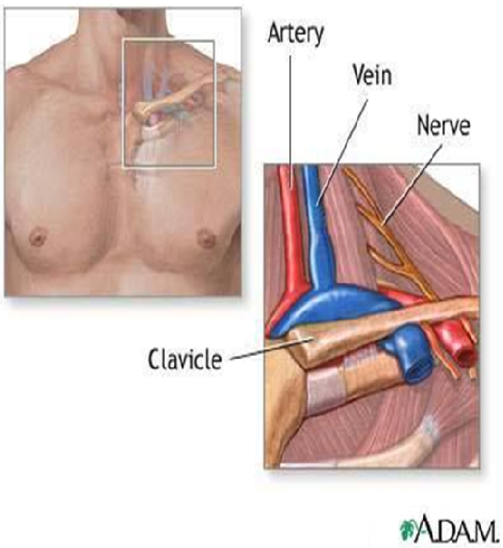
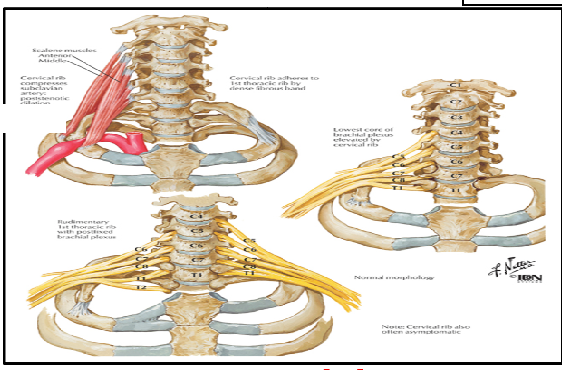
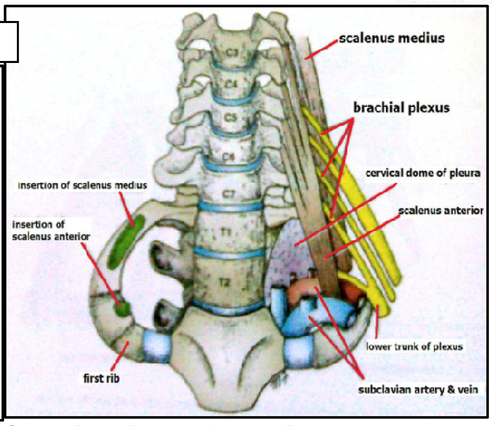


Fig.7.15





Anatomy Of The Root/Base Of Neck (Thoracic Outlet)

Fig.7.16

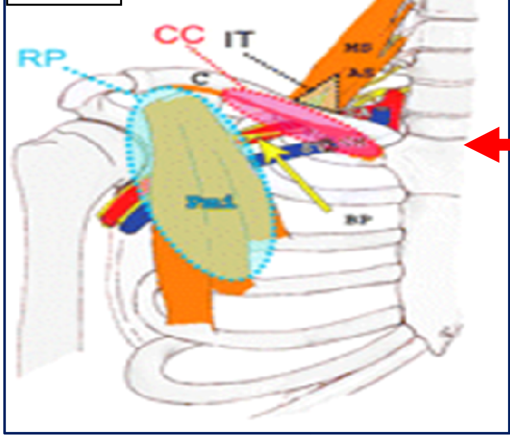
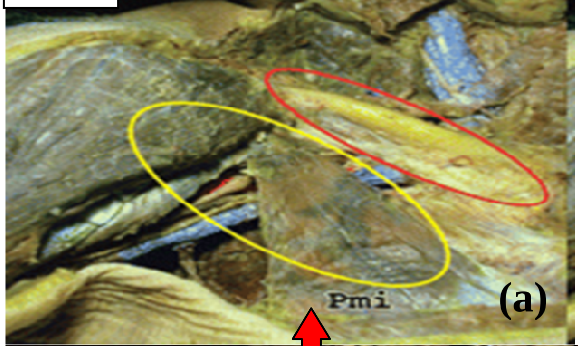
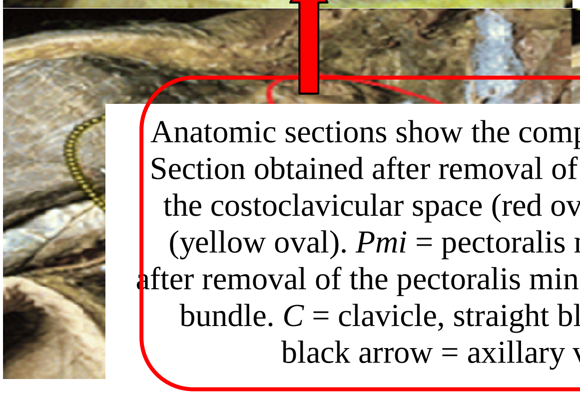


Diagram shows the three compartments of the thoracic outlet and their components. *AS* = anterior scalene muscle, *BP* = brachial plexus, *C* = clavicle, *CC* = costoclavicular space, *IT* = interscalene triangle, *MS* = middle and posterior scalene muscles, *Pmi* = pectoralis minor muscle, *RP* = retropectoralis minor space, *SA* = subclavian artery, *SM* = subclavius muscle, *SV* = subclavian vein.

Fig.7.17



(b)



Anatomic sections show the compartments of the thoracic outlet. **(a)** Section obtained after removal of the pectoralis major muscle shows the costoclavicular space (red oval) and retropectoralis minor space (yellow oval). *Pmi* = pectoralis minor muscle. **(b)** Section obtained after removal of the pectoralis minor muscle shows the neurovascular bundle. *C* = clavicle, straight black arrow = axillary artery, curved black arrow = axillary vein, white arrow = brachial plexus

Cervical Rib

Fig.7.18

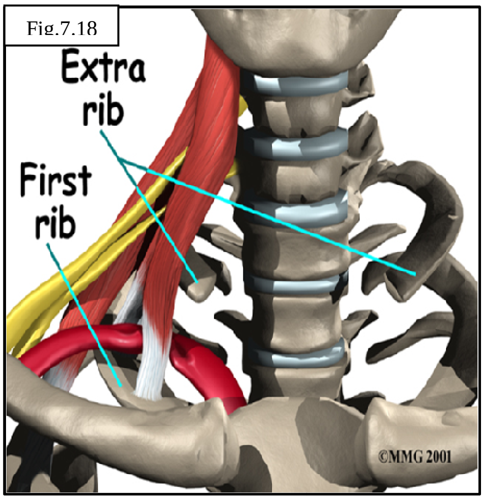
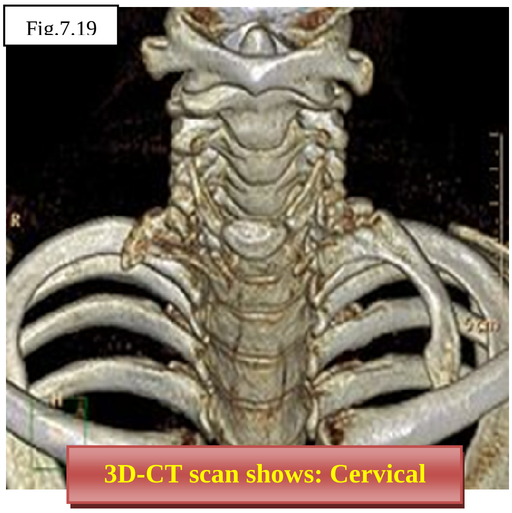


Fig.7.19



3D-CT scan shows: Cervical

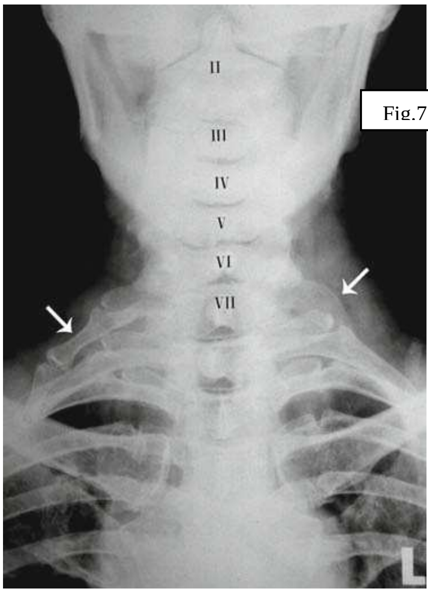


Fig.7.20

X-Rays show: Cervical Ribs

Palpation:

From the front:

- ✓ The patient seated.
- ✓ The examiner standing behind him.
- ❖ Any swelling:
  - ➢ Lymph nodes.
  - ➢ Parotid gland.
  - ➢ Submandibular glands.
  - ➢ Thyroid gland.
  - ➢ Muscles.
  - ➢ Mandible.
  - ➢ Clavicle.
  - ➢ Any tenderness.

From the back:

- ✓ The patient lying prone and resting his head over a pillow.
- ✓ And seating and the examiner standing behind him.
- ✓ Palpate the spinous process and count them.
- ➢ The most prominent spinous process of the neck is C_7.
- ➢ The most prominent spinous process of the whole spine is T_1 (Th_1).
- ➢ The lymph nodes.
- ➢ The muscles (mainly in children the sternomastoid tumour).
- ➢ The mastoid bone (Tumour, Infection).

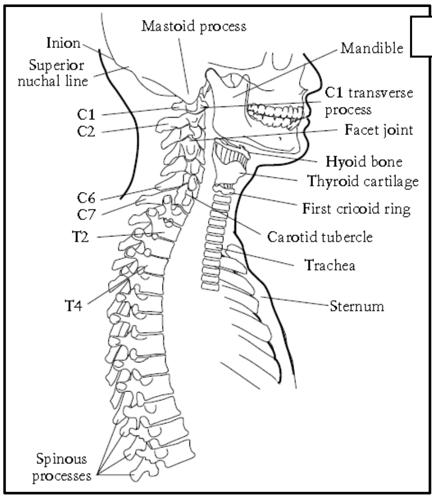
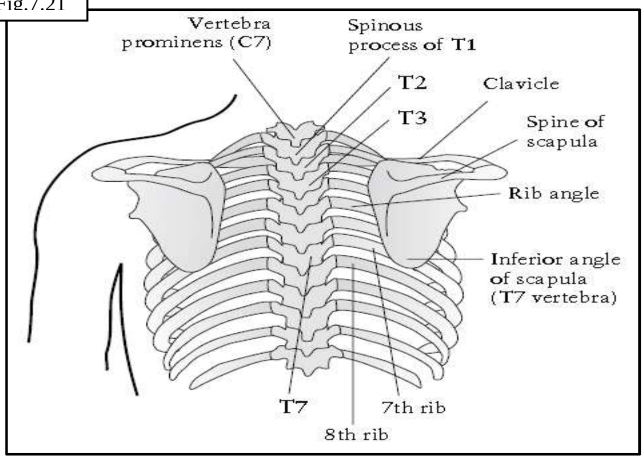
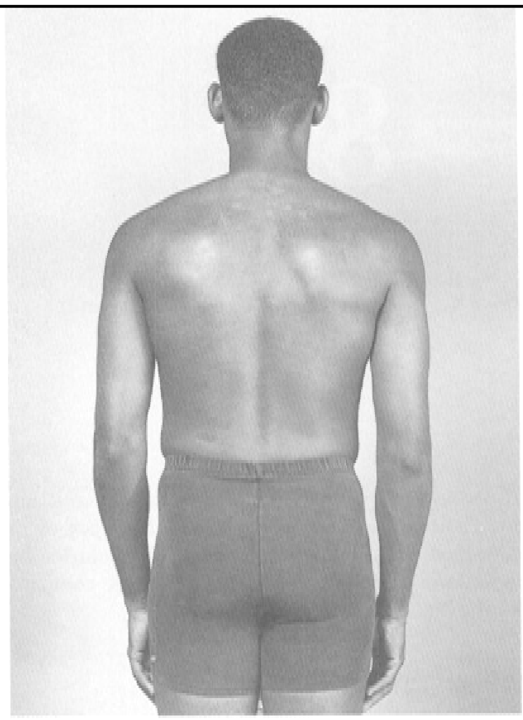
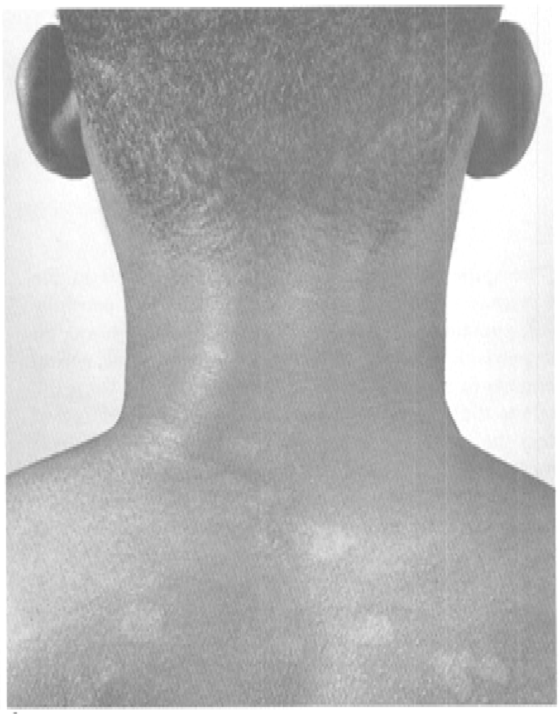


Fig.7.21

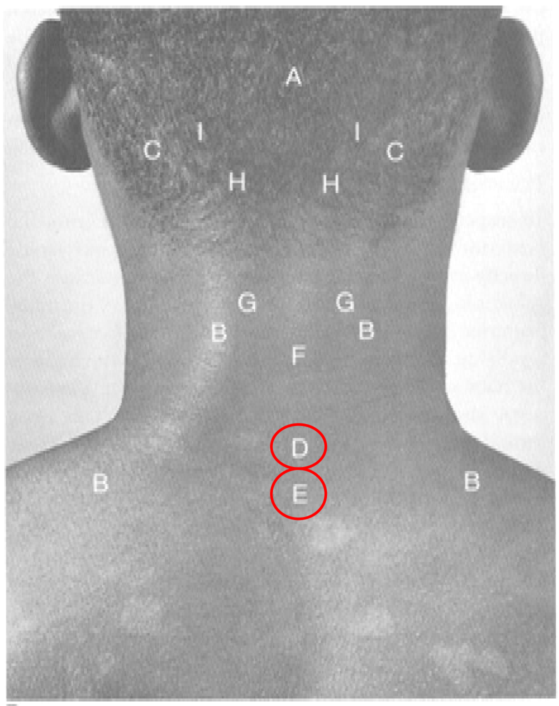




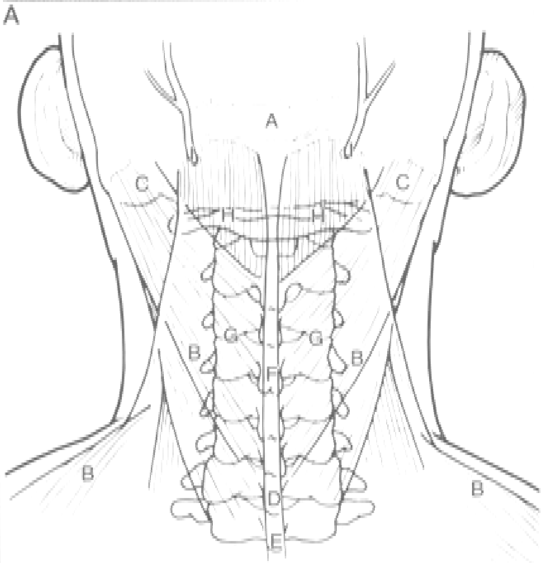
Posterior aspect of the spine.



A

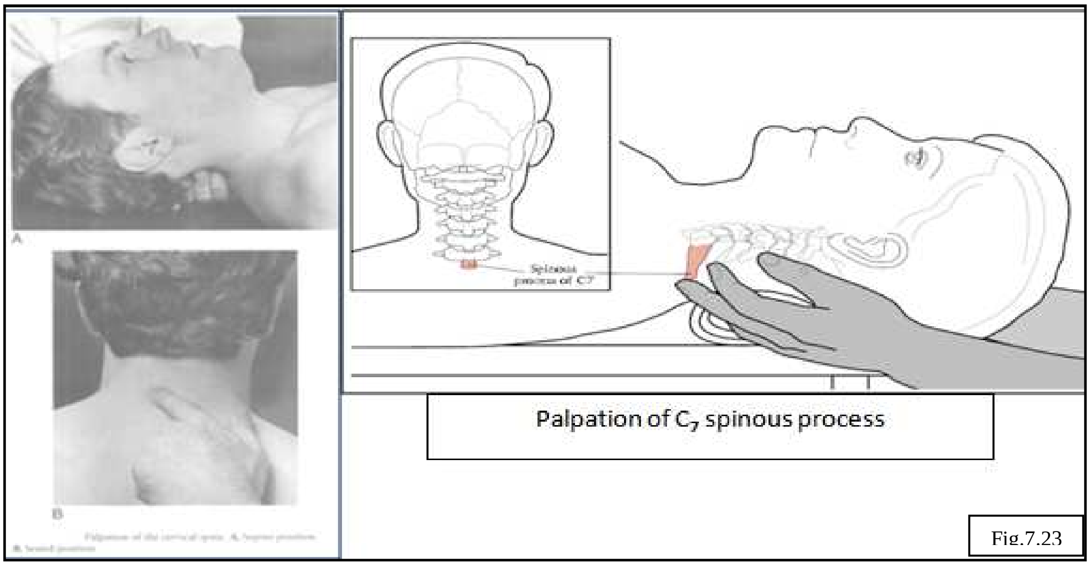


B



C

Fig.7.22 ***A, B,*** and ***C,*** Posterior aspect of the neck. *A,* inion; *B,* trapezius; *C,* transversocostal muscle group; *D,* C7 spinous process; *E,* T1 spinous process; *F,* nuchal ligament; *G,* posterior facet joint; H, suboccipital muscles; *I,* greater occipital nerve.



Palpation of C_7 spinous process

Fig.7.23

Movement:

Flexion: The chin touch the region of the sterno-clavicular joints (the chin touch the chest).

- Normal range= 80°

Extention: The plane of the nose and forehead should normally be nearly horizontal.

- Normal range= 50°

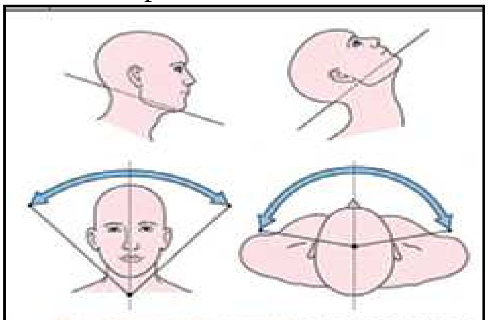
Lateral flexion: The ear touch the shoulder (with only slight shrugging of the shoulder).

- Normal range= 45°

Rotation: the chin falls just short of the plane of the shoulder.

Normal range= 80°

Note: A spatula may be used as a pointer for measurement.



Normal range of movement Flexion and extension of the neck are best gauged by observing the angle of the occipitomental line – an imaginary line joining the tip of the chin and the occipital protuberance. In full flexion, the chin normally touches the chest; in full extension, the occipitomental line forms an angle of at least 45° with the horizontal, and more than 60° in young people. Lateral flexion is usually achieved up to 45° and rotation to 80° each way.

Fig.7.24

Power: Examine the power of the muscles of the neck:

- The flexors.
- The extensors.
- The rotators.

Sensation: Examine the sensation of the upper limbs and if necessary the lower limbs.
Reflexes: Examine the reflexes of the upper limbs.

Special tests:

1) Adson's test:

- Stand behind the patient.
- Detect the radial pulse.
- Abduct the patient's shoulder around 30^{o}.
- Check the pulse_ present or absent.
- Extend the shoulder backward with the elbow in extension (The limb in anatomic position).
- Check the pulse_ Present or absent.
- Ask the patient to take a deep breath and to hold it.
- Check the pulse_ Present or absent.
- Ask the patient to turn his head fully to the affected side.
- Obliteration of the pulse or reduction in comparison with the other side is usually significant indicting subclavian artery narrowing due to compression (Scalenous anterior syndrome, Cervical rib).

Adson's Test

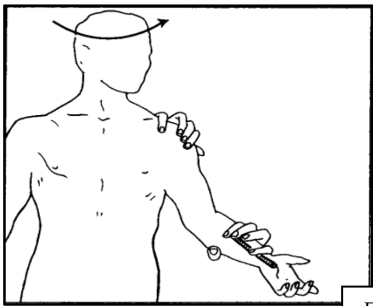
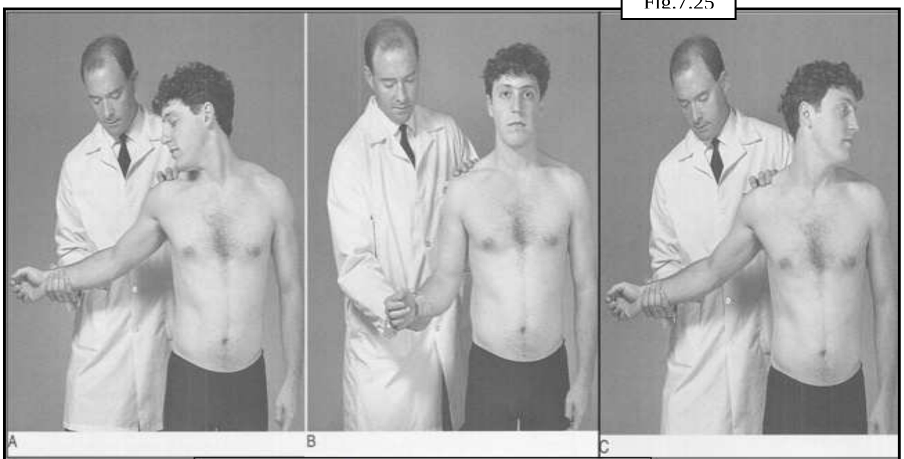


Fig.7.25



Adson's test

2) Wright's test:

- ➢ The arms are abducted and externally rotated,
- ➢ The pulse disappears on the abnormal side.

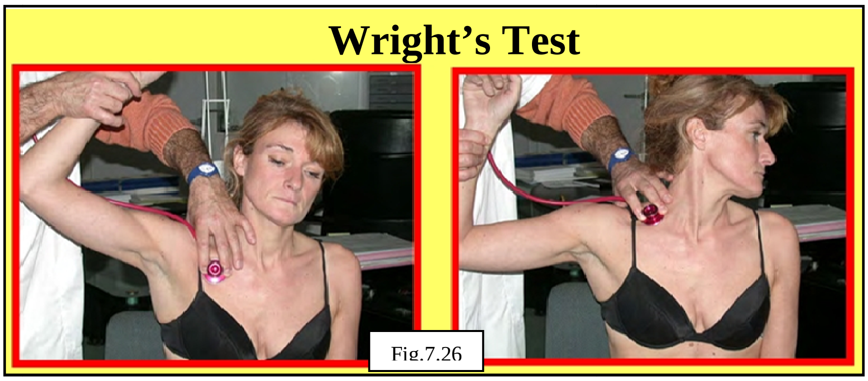


Fig.7.26

3) Roos's test:

- ➢ Ask the patient to hold his arms high above their head and then open and close the fingers rapidly.
- ➢ This may cause cramping pain on the affected side.

Note: Unfortunately these tests are neither sensitive nor specific enough to clinch the diagnosis.

Fig.7.27

A, B
Roos test. The patient opens and closes the hands for one minute.

Cervical spine

- ***X-Ray:***

- The standard radiographic series for the cervical spine comprises anteroposterior, lateral and open-mouth views. Additional lateral views with the neck in flexion and extension should be obtained provided there is no history of recent neck injury.

- The anteroposterior view should show the regular, undulating outline of the lateral masses; their symmetry may be disturbed by destructive lesions or fractures. A projection through the mouth is required to show the upper two vertebrae.

- When looking at the lateral view, *make sure that all seven vertebrae can be seen*; patients have been paralysed, and some have lost their lives, because a fracture-dislocation at C6/7 or C7/T1 was missed.

- The normal cervical lordotic curve shows four parallel lines: one along the anterior surfaces of the vertebral bodies, one along their posterior surfaces, one along the posterior borders of the lateral masses and one along the bases of the spinous processes; any malalignment suggests subluxation.

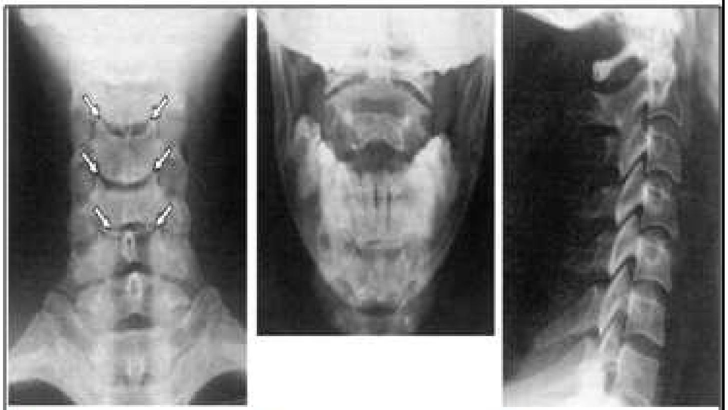
- The disc spaces are inspected; loss of disc height and the presence of osteophytic spurs at the margins of adjacent vertebral bodies suggest chronic intervertebral disc degeneration. The posterior interspinous spaces are compared; if one is wider than the rest, this may signify chronic instability of that segment, possibly due to a previously undiagnosed subluxation. Flexion and extension views may be needed to demonstrate instability, though after an acute injury this is best avoided!

- *Children's x-rays* present special problems. Because the ligaments are relatively lax and the bones incompletely ossified, flexion views may show unexpectedly large shifts between adjacent vertebrae; this is sometimes mistaken for abnormal subluxation. Thus, during flexion, the lateral x-ray may show an atlanto-dental interval of 4 or 5 mm (which in an adult would suggest rupture of the transverse ligament), or anterior 'subluxation' at C2/3.
  Note also that the retropharyngeal space between the cervical spine and pharynx at the level of C3 increases markedly on forced expiration (e.g. when crying) and this can be misinterpreted as a soft-tissue mass.

- Another error is to mistake the normal synchondrosis between the dens and the body of C2 (which only fuses at about 6 years) for an odontoid fracture.

- Finally, remember that normal- looking radiographs in children do not exclude the possibility of a spinal cord injury.

Cervical spine – normal x-ray In the lateral projection, four parallel lines can be traced unbroken from C1 to C7. They are formed by: (1) the anterior surfaces of the vertebral bodies; (2) the posterior surfaces of the bodies; (3) the posterior borders of the lateral masses; and (4) the bases of the spinous processes.

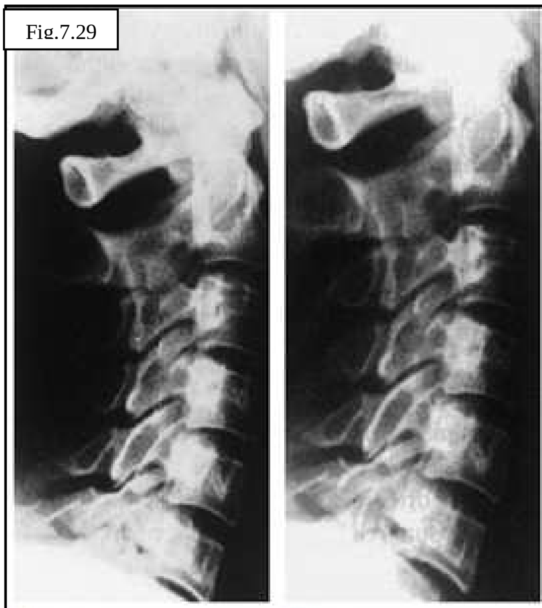


(a) (b) (c)

Imaging – normal x-rays (a) Anteroposterior view – note the smooth, symmetrical outlines and the clear, wide uncovertebral joints (arrows). (b) Open mouth view – to show the odontoid process and atlanto-axial joints. (c) Lateral view – showing all seven cervical vertebrae.

Fig.7.28

Fig.7.29



(a) (b)

Cervical spine injuries – x-ray diagnosis
(a) Following a traffic accident this patient had a painful neck and consulted her doctor three times; on each occasion she was told 'the x-rays are normal'. But count the vertebrae! There are only six in this film. (b) When a shoulder 'pull-down view' was obtained to show the entire cervical spine, a dislocation of C6 on C7 could be seen at the very bottom of the film.

Fig.7.30

(a) (b)

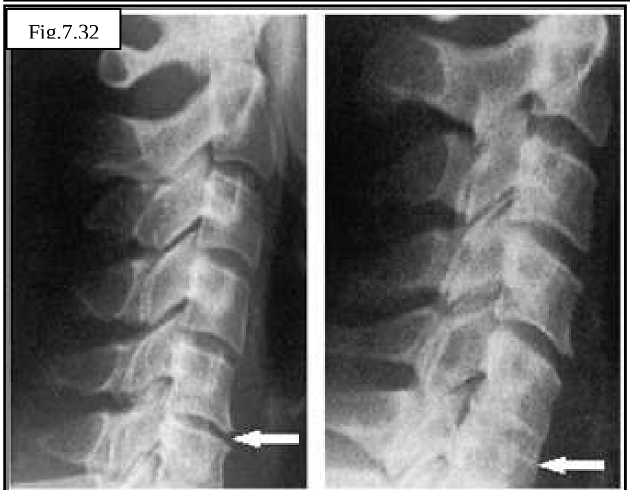
Pyogenic infection (a) The first x-ray, taken soon after the onset of symptoms, shows narrowing of the C5/6 disc space but no other abnormality. (b) Three weeks later there is dramatic destruction and collapse; the speed at which these have occurred distinguishes pyogenic from tuberculous infection.

Fig.7.31

(a) (b) (c) (d)

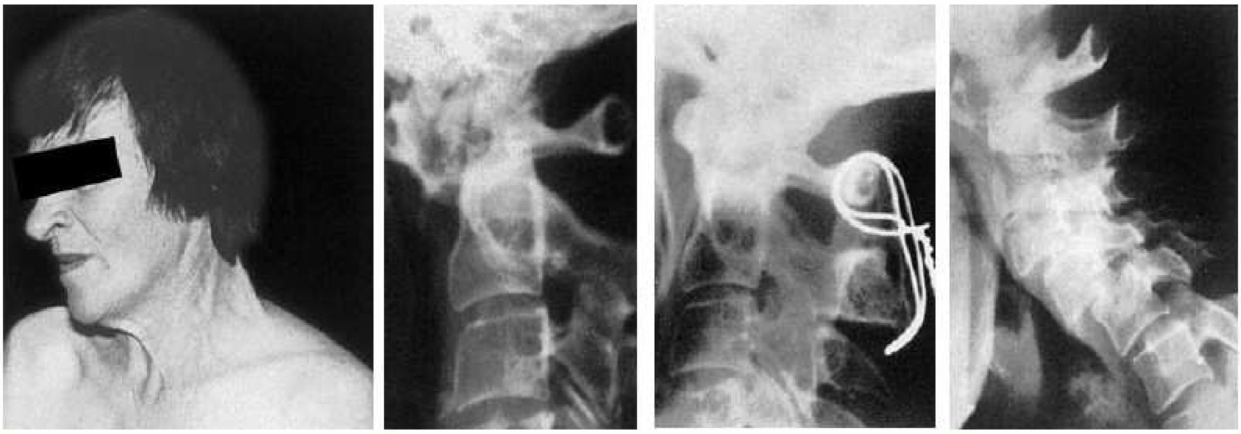
Acute disc prolapse (a,b) Acute wry neck due to a prolapsed disc. (c) The intervertebral disc space at C5/6 is reduced. (d) MRI in another case showing a large disc prolapse at C6/7.

Fig.7.32



(a) (b)

Cervical disc prolapse – treatment (a,b) Operative treatment usually consists of anterior disc removal and bone grafting. In this case the intervertebral disc height at C5/6 has been restored but now, some years later, there are signs of disc degeneration above and below the fused segment.



(a) (b) (c) (d)

Fig.7.33

Rheumatoid arthritis (a) Movement is severely restricted; attempted rotation causes pain and muscle spasm. (b) Atlanto-axial subluxation is common; erosion of the joints and the transverse ligament has allowed the atlas to slip forward about 2 cm; (c) reduction and posterior fusion with wire fixation. (d) This patient has subluxation, not only at the atlanto-axial joint but also at two levels in the mid-cervical region.

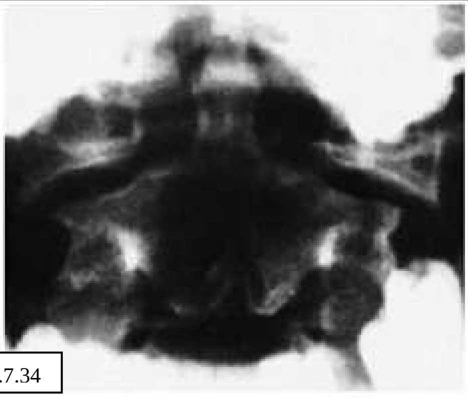


Fig.7.34

Fracture of C1 ring Jefferson's fracture – bursting apart of the lateral masses of C1.

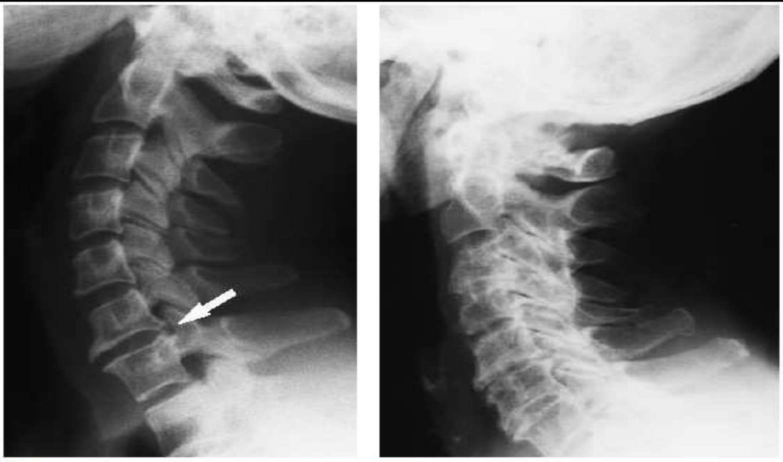
Fig.7.35

Fracture of C2 'Hangman's fracture' – fracture of the pars interarticularis of C2.

Fig.7.36

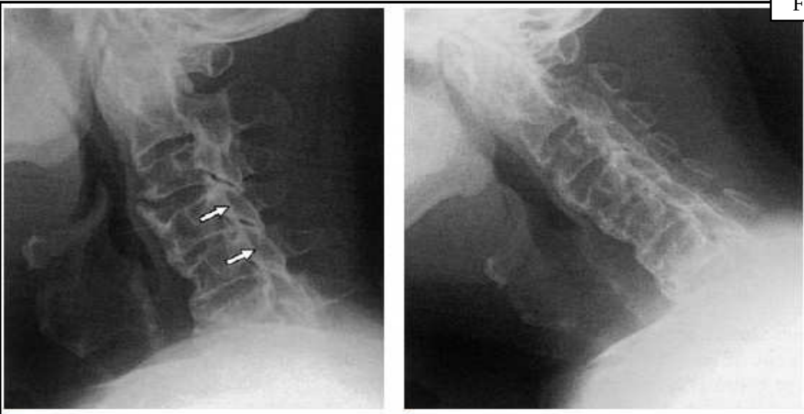
17.6 Klippel–Feil syndrome The short neck and vertebral anomalies in a typical patient.

Fig.7.37



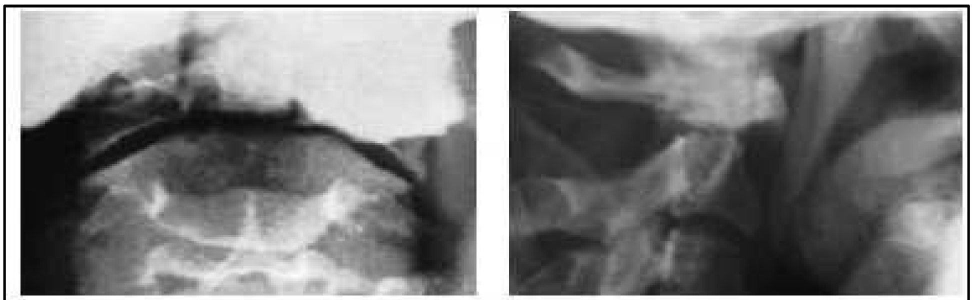
(a) (b)

17.9 Cervical spondylosis – x-rays (a) Degenerative features at one level, C6/7. Note the prominent 'osteophytes' at the anterior and posterior borders of these two vertebral bodies. (b) Marked degenerative changes at multiple levels.



(a) (b)

Fig.7.38 Ossification of the posterior longitudinal ligament (a) Lateral x-ray of the cervical spine showing the thin dense band running down the backs of the vertebral bodies (arrows); this appearance is typical of posterior longitudinal ligament ossification, which resulted in cervical spinal stenosis. (b) X-ray taken after posterior spinal decompression (laminoplasty); the spinous processes have been removed, the laminae split on one side of the mid-line and the posterior arch 'jacked' open. The sagittal diameter of the spinal canal is now considerably greater than before. (Courtesy of Mr H. K. Wong, Singapore.)



(a) (b)

Fig.7.39 Fractured odontoid process (a) Anteroposterior 'open-mouth' x-ray showing a Type II odontoid fracture. (b) Lateral x-ray of the same patient.

Chapter 8
The Back

History:

Pain Stiffness Deformity	In the back
Pain Paraesthesia Weakness	In the lower limbs

Pain:

- sharp and localized.
- chronic and diffuse.

Felt low down on either side of the midline often extending into the upper part of the buttock and even into the lower limbs.

-Back pain_ made worse by rest would suggest pain raising from the facet joints.

-Back pain_ made worse by activity probably from soft tissue (muscles, ligaments, annulus of intervertebral disc).

Sciatica: Intense pain radiating from the buttock into the thigh and calf along the course of the sciatic nerve (Nerve irritation or compression).

Stiffness:

(1) Sudden in onset and almost complete ('locked back' attack, or often disc prolapsed).

(2) Continuous and predictably worse in the mornings (arthritis or ankylosing spondylitis).

Deformity: usually noticed by others

- Scoliosis.
- Kyphosis.
- Lordosis.

Numbness or Paraesthesia:

- Over one of the dermatomes.
- If aggravated by standing or walking and relieved by sitting down_ classic symptoms of spinal (or foramenal) stenosis.

Urinary retention or incontinence: can be due to pressure on cauda equine.

Faecal incontinence or urgency, and impotence: may also occur due to spinal lesion.

Uretheral discharge, diarrhea, sore eyes: classic features of Reiter's disease.

1) Causes Of Backache:

- There are many causes of backache and it is useful to group them.

I- Injury:

(1) ***Twisting forces:*** causing muscle injury (sometimes with a fractured transverse process).
(2) ***Lifting strain:*** causing ligament injury ('sprung back') or disc prolapsed.
(3) ***Crushing force:*** causing bony injury (compression fracture).

- In all these the onset is sudden, after strain or violence.
- The patient is otherwise fit, and the x-ray appearance is normal or shows a fracture.

II- Degeneration:

- The back is mechanically unsound and joint degeneration develops because of some underlying structural fault.

(1) ***Lumbar instability*** and spondylosis following previous disc prolapse.
(2) ***Lumbar strain:*** due to spinal deformity (Thoracic kyphosis often gives lumbar pain because this area is constantly under strain to keep the patient upright).
(3) ***Osteoarthritis*** of the facet joints.

- In all these conditions the onset is gradual, though often there is a history of previous back trouble.
- The pain is worse after strain and better after rest.
- The patient has no general illness.
- X-rays show lipping of the vertebral bodies and may reveal the deformity.

III- Spinal disease:

(1) ***Inflammation:*** The most important chronic inflammatory conditions are T.B and ankylosing spondylitis.
- Pyogenic osteomyelitis is rare but may present acutely.

(2) ***Tumours:*** The most common Tumour is a secondary vertebral deposit.
- Other tumour may involve the cord, meninges or nerve roots.
- Vertebral haemangioma is often symptomless.

(3) ***Paget's disease***

- In all these conditions the onset is not sudden or with violence.
- The patient may have other evidence of disease, the ESR may be raised and x-ray often reveal the cause.

IV- Sacroiliac disease:

- Sacroiliac disease, especially if bilateral, causes backache indistinguishable from that of lumbosacral disease.
- The common causes are:
  - *Ankylosing spondylitis.*
  - *Reiter's disease.*

  -Other features (such as urogenital infection and conjunctivitis) may be present and the ESR is often raised.

V- Disease elsewhere:

- Backache occurs in non-spinal conditions as follows:
  (1) ***Any acute febrile illness:*** e.g. influenza.
  (2) ***Disorders of abdominal viscera:*** e.g. the stomach, duodenum, pancreas and urogenital tract.
  (3) ***Disorders, including carcinoma and presacral malignant deposits, of the pelvic viscera:*** e.g. the uterus, ovaries, bladder and rectum. (Hence the importance of rectal and vaginal examination).
- In all these conditions the onset is not sudden or with violence.
- There is other evidence of disease.
- X-Rays of the spine itself are normal.

VI- Idiopathic:

- In many patients the cause of backache is never found.
- It is attributed to the following:
  (1) ***Poor posture.***
  (2) ***Overwork.***
  (3) ***Mental depression.***
- These are grist to the mill of the osteopath.

2) Causes Of Sciatica:

I- inflammation:

(1) Rarely, in sciatica there is a true neuritis (e.g. diabetic or alcoholic).
(2) Arachnoiditis may follow repeated surgery or myelography.

- In these conditions the onset is not sudden, the patient is unfit, the nerve itself is tender and peripheral neurological signs are present.

II- Compression of a nerve:

(1) ***In the vertebral canal:*** Compression is usually due to a prolapsed disc, occasionally to tuberculous material or to a tumour of the cauda equine or meninges.
(2) ***In the intervertebral foramen:*** Compression may arise from a tumour of the root, a lymphadenomatous deposit or because of narrowing of the foramen in spondylolisthesis, or osteophyte.
(3) ***In the pelvis or buttock:*** Compression may arise from an abscess, a hematoma or a tumour if impacted or adherent to the nerve.

- In all these; stretching the nerve is painful.
- A prolapsed disc is much the most common cause, and also the most innocuous.
- A mass in the buttock shows on computerized tomography (CT-scan).

III- Referred:

- Pain may be referred from spinal ligaments or unstable facet joints.
- ‘Fibrositic’ pain is probably of this nature.
- In this condition there are tender areas on which pressure may also provoke sciatic pain.
- Local anesthesia abolishes both the local and the referred pain.
- The patient is otherwise fit.

- The x-ray appearance of the spine is often normal.

Physical Examination

- Strip the patient to their underclothes.
- The patient examined:
  - (1) first standing, then
  - (2) lying face downwards, then
  - (3) lying face upwards.

Gait: Ankylosing spondylitis – Bending forward
-High stip gait – drop foot – chronic compression.

Attitude: tilt to the left or right or forward _ pain relieve.

Posture:

- Scoliosis
- Kyphosis
- Lordosis
- Strieght spine (obliteration of the lordosis) _ muscle spasm due to pain.

Kyphosis:

A) *Regular (Round).*

Fig 8.1

B) *Angular (Knuckle).*

Fig 8.2

A) Kyphosis: Regular:

- If it is regular and mobile→ Postural kyphosis.
- If regular and fixed:
  - a) Senile kyphosis (osteoporosis, osteomalacia, pathological fracture).
  - b) Scheuermann's disease.
  - c) Ankylosing spondylitis.

B) Kyphosis: Angular:

a) Fracture (Traumatic or pathological).
b) T.B spine.

c) Congenital vertebral abnormality (Hemivertebra).

Fig 8.3

Flattening (or strieght) spine _ obliteration of the lumbar lordosis:

a) Disc prolapse.
b) Osteoarthritis (spondylosis).
c) Infections of the vertebral bodies.
d) Ankylosing spondylitis.

Flexion of the spine, hips and knees
(Simian stance) _ Spinal Stenosis?

- Sometime the increase of the lumbar curvature in women is normal.
- Increase the curve is found with prominence of the spinous process of L_5 and the sacrum in spondylolisthesis.
- It may be secondary to kyphosis.
- It may be secondary to flexion deformity of the hips.

Fig 8.4

From behind:

- **Note:**
  (1) Café-an-laits spots which may suggest neurofibromatosis and associated scoliosis.

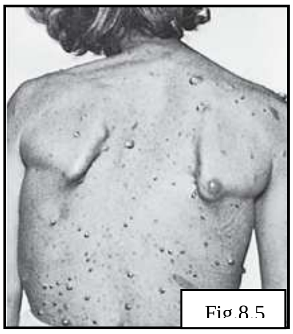


Fig 8.5

  (2) A fat pad or hairy patch suggestive spina bifida.

Fig 8.6

  (3) Scarring suggestive of previous thoracotomy and possible thorocogenic scoliosis or spinal surgery.

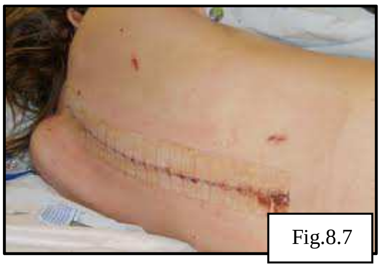


Fig.8.7

- Note the presence of any lateral curvature (scoliosis)_ The most commonest scoliosis is a protective scoliosis or list in the lumbar region secondary to a prolapsed intervertebral disc not whether the shoulders and hip are level. (????)
- In considering other causes of scoliosis, examine the spine with the patient sitting.
    - ➢ Obliteration of an abnormal curve suggests that the scoliosis is mobile and secondary to shortening of leg; → check relative leg lengths.
- If on sitting the scoliosis persists, ask the patient to bend forwards; if the curve disappears, this suggests that it is quit mobile and most likely to be postural in origin.
- If the curvature remains, this suggests that the scoliosis is fixed→(structural scoliosis); if a rib lump is present, this confirms the diagnosis.
- In case of infantile scoliosis, assess the rigidity of a curvature by noting any alterations as the child is lifted by the armpits.

Palpation:

- Ask the patient to lean forwards if possible.
- Look for tenderness:
    - ➢Between the spines of the lumbar vertebrae and lumbo-sacral junction (common in intervertebral disc prolapsed).
    - ➢Over the lumbar muscles (Disc prolapsed + mechanical back pain).
- Slide the fingers down the lumbar spine on to the sacrum; →a palpable step at the lumbo-sacral junction is a feature of spondylolesthesis.

Percussion:

- Ask the patient to bend forwards.
- Lightly percuss the spine in an orderly progression from the root of the neck to the sacrum.
- Marked pain is a feature of tuberculous and other infections.

Movements:

Flexion: Normal range = 45^o thoracic,
= 60^o lumbar.
Or reach by fingers the floor or within 7 cm from it.

Extension: Ask the patient to arch his back, assisting him by steadying the pelvis and pulling back on the shoulder.
Normal range = 25^o thoracic.
=35^o lumbar.

Lateral flexion: Ask the patient to slide the hands down the side of each leg in turn, and record the point reached:

- ➢ Either in Cm from the floor,
- ➢ Or the position the fingers reach in the legs.
- The average range is 30^o

Rotation:

- ➢ The patient should be seated, and asked to twist round to each side.
- ➢ Rotation is measured between the plane of the shoulders and the pelvis.
- The normal range is 40^o and is almost entirely thoracic.

Power: Examine the power of the muscles of the spine and of the lower limbs:

- *Flexors,*
- *Extensors,*
- *Rotators.*

Sensation: Examine the dermatomal distribution of the lower limbs.

Reflexes: Examine the reflexes of the lower limbs.

Special test:

Straight leg raising test: This test is designed to reproduce back and leg pain so that its cause can be determined. Instruct the patient to lie supine on an examining table. Lift his leg upward by supporting his foot around the calcaneus. The knee should remain straight. To insure that it does, place your free hand on the anterior aspect of the knee to prevent it from bending. The extent to which the leg can be raised without discomfort or pain varies, but normally the angle between the leg and the table measures approximately 80^o. If the straight leg raising is painful, you must determine whether pathology is due to problems in the sciatic nerve or to hamstring tightness.
Hamstring pain involves only the posterior thigh, whereas sciatic pain can extend all way down the leg. The patient may also complain of lower back pain, and on occasion, pain in the opposite leg (positive cross leg straight leg raising test).
At the point where the patient experiences pain, lower the leg slightly, and then dorsiflex the foot to stretch the sciatic nerve and reproduce sciatic pain.
If the patient does not experience pain when you dorsiflex his foot, the pain induced by straight leg raising is probably due to tight hamstring. If there is a positive reaction to the straight leg raising test and the dorsiflexion maneuver, ask the patient to locate, as nearly as possible, the source of his pain. It may be either in the lumbar spine or anywhere along the course of the sciatic nerve.

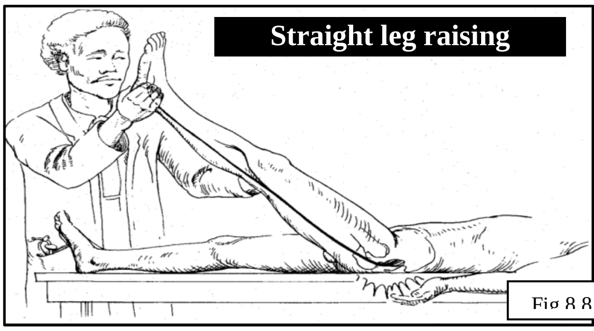


Fig 8.8

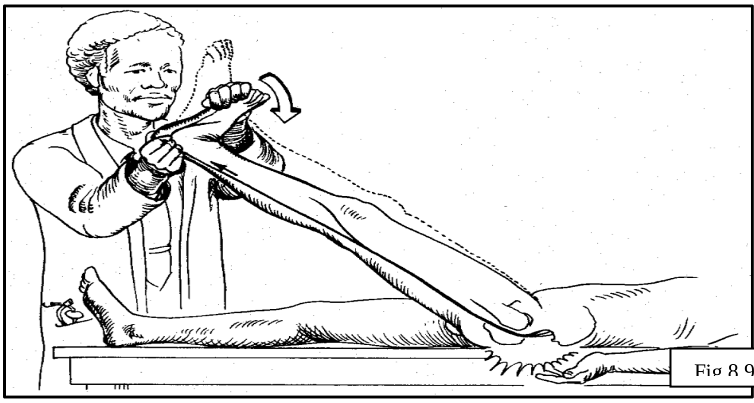
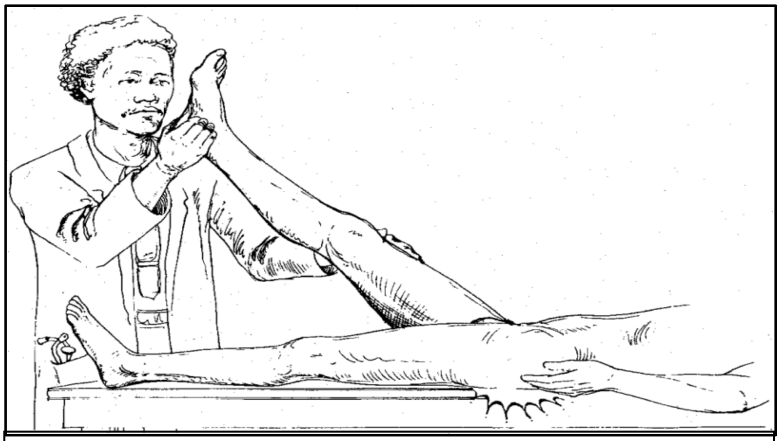


Fig 8.9

In this position, dorsiflexion of the foot reproduce sciatic

Well Leg Straight Leg Raising Test: Have the patient lie supine and raise his uninvolved leg. If he complains of back and sciatic pain on the opposite (involved) side, there is further presumptive evidence of a space-occupying lesion such as a herniated disc in the lumbar area. This test is also referred to as the opposite leg, or positive cross leg straight leg raising test.



A positive straight-leg raising test: *Back pain on the involved side induced by straight leg raising the non-involved leg.*

Fig 8.10

Bowstring sign or test: A further confirmatory test is the **bowstring sign**.
With the onset of pain, the posterior tibial nerve is stretched like a bowstring across the popliteal fossa. Pressure on the nerve in the center of the fossa causes pain in the back of the leg (positive bowstring sign).

Fig 8.11

Reverse laseque test:

(1) The patient should be prone. Flex each knee in turn. This give rise to pain in the appropriate distributions (by stretching of femoral nerve roots) in high lumbar disc lesion (or suspected prolapsed intervertebral disc).

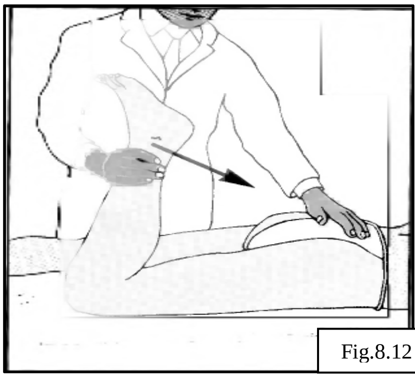


Fig.8.12

(2) The pain produced in such a test, if positive, is normally aggravated by extension of the hip, and this should be noted. Attempt this with the knee flexed to 90^o and also fully flexed. High disc lesions are rare compared with those affecting the $L_5 – S_1$ and $L_4 – L_5$ spaces. Note also that pain in the ipsilateral buttock or thigh on full knee flexion may occur in more distally situated disc prolapses.


Fig.8.13

Coin test:

when the disease is active, no matter the situation, the patient walks with the leg joints semi-flexed, to lessen the jar of sudden movements. In addition, disease in each situation is associated with a characteristic gait or attitude e.g. bending the hips and knees instead of the spine when picking up an object from the floor.


Fig.8.14

Gaenslen's sign: Have the patient lie supine on the table, and ask him to draw both legs onto his chest. Then shift him to the side of the table so that one buttock extends over the edge of the table while the other remain on it. Allow his unsupported leg to drop over the edge, while his opposite leg remains flexed. Complaints of subsequent pain in the area of the sacroiliac joint give another indication of pathology in that area.

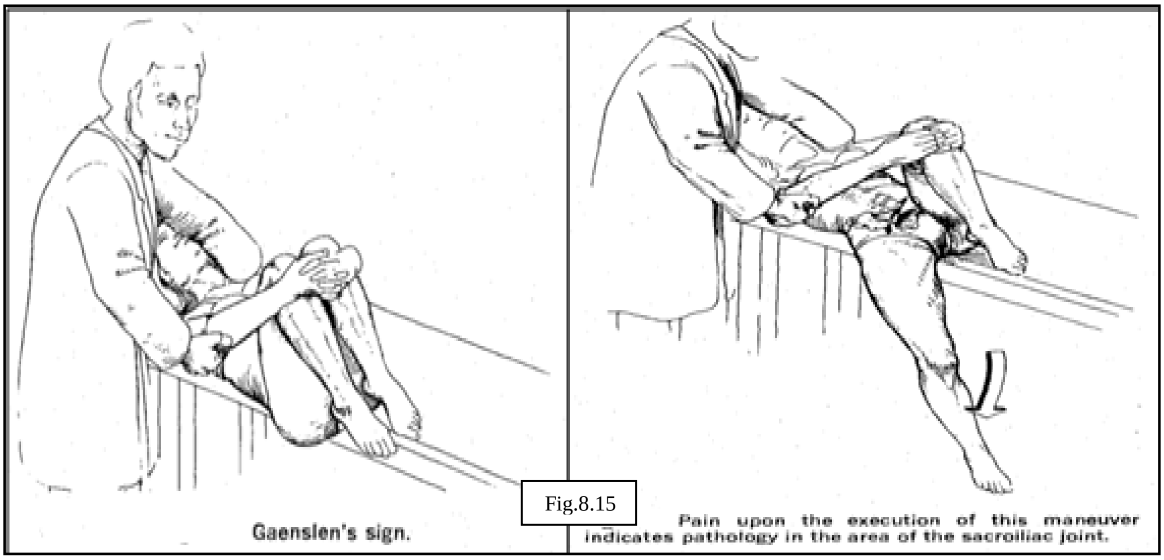


Fig.8.15

❖ ***Note:*** Drop foot – indicating sciatic nerve injury.

Assessment of Scliosis

Infantile idiopathic scoliosis (0-3 Years)
I- Progressive – increasing rapidly 10 – 30 %

- When the curve measures more than 37 degree by cobb method when first seen .
- When compensatory or secondary curves develop .

II- Resolving (Structural resolving) spontaneously within a few years with or without treatment 70 – 90 %

- If the curve measures only 10 to 15 degree when first seen .

! When the curve is mild , No obsolute criteria are available for differentiating the two types .

The RVAD (The Rip – Vertebral Angle Difference)

- Any curve with an intial RVAD of 20 degrees or more is considered progressive until prove otherwise .
- Whether or not a given curve is progressive can be determined by observing it for at least 6 months .

The RVA is measured by drawing one line perpendicular to the apical vertebral endplate and another from the midneck to the medhead of the corresponding Rib .
The angle formed by the intersection of these lines is the RVA .

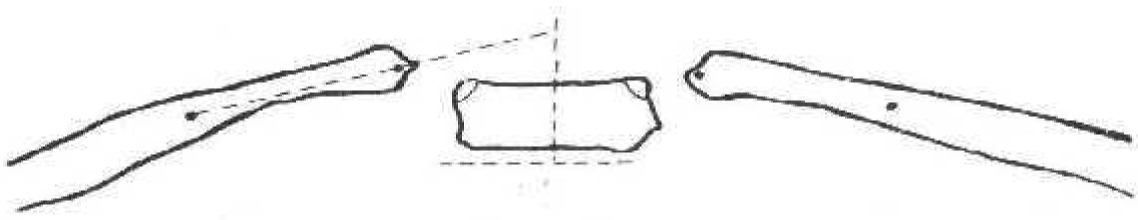


Fig.8.16 Construction of rib-vertebral angle (RVA)

Juvenile idiopathic scoliosis (4-10 Years)

- For curves of less than 20 degrees , observation indicated .
- X-ray each 4 – 6 months .
- More than 30 degrees curve progressive .
- The intial RVAD was not helpful , but progressive RVAD to greater than 10 degrees over time was associated with curve progression .
- A higher incidence of curve progression also was noted in patients with less than 20 degrees of thoracic kyphosis .
- Double major curves tended to progress most often .

Evaluation of brace treatment of juvenile idiopathic scoliosis using the RVAD

If the RVAD progresses above 10 degrees during brace wear, progression can be expected.
If the RVAD values decline as treatment continues, part-time Milwaukee brace wear should be adequate.
Those curves with RVAD values near or below 0 degrees at the time of diagnosis generally will require only a short period of full-time brace wear before part-time brace wear is begun.

Adolescent idiopathic scoliosis (10-16 Years)

- Idiopathic scoliosis curves of more than 10 degrees are estimated to occur in 2% to 3% of children younger than 16 years of age .
- Once scoliosis has been discovered in a child , the curve must be evaluated for the probability of progression .
- The progression defined as an increase of 5 degrees or more measured by the cobb measurement over two or more vists (4-6 months interval).
- Certain factor have been found to be related to curve progression .

Factors related to progression of adolescent idiopathic scoliosis

Girls > boys
Premenarchal
Risser sign of 0
Double curves > single curves
Thoracic curves > lumbar curves
More severe curves

Measurement of curves (The Cobb method)

Recommended by the (Terminology committee of the scoliosis Research society)

- It consists of three steps :
  1) Locating the superior end vertebra .
  2) Locating the inferior end vertebra .
  3) Drawing intersecting perpendicular lines from the superior surface of the superior end vertebra and from the inferior surface of the inferior end vertebra .
- The angle of deviation of these perpendiculars from a straight line is the angle of the curve

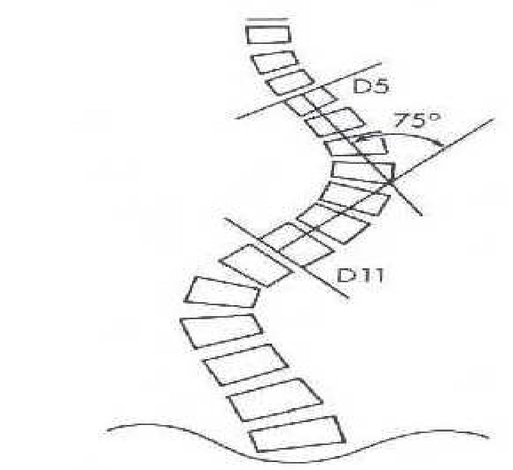


Fig.8.17 iagram of Cobb method

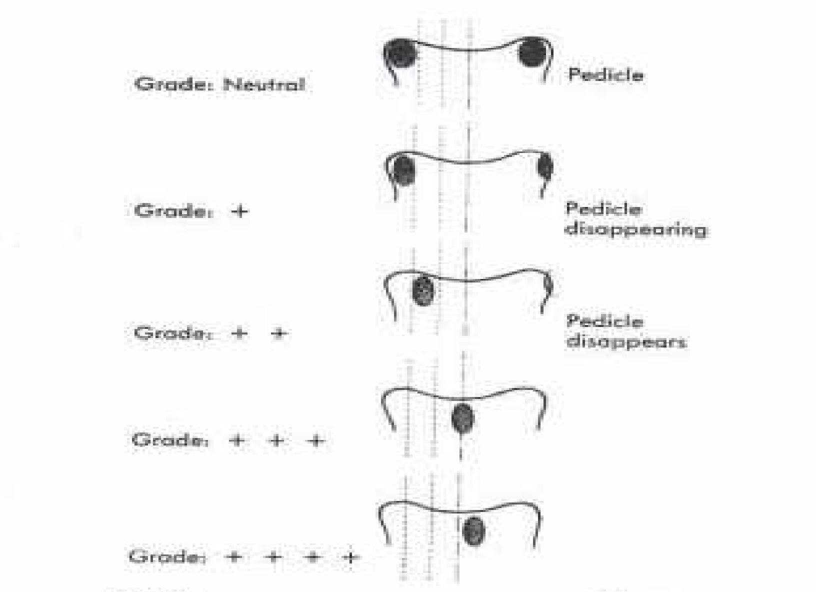
- If the endplates are obscured , the pedicles can be used instead .
- The end vertebra of the curve is the one that tilts the most into the concavity of the curve being measured .

- When moving away from the apex of the curve , the next intervertebral space below the inferior end vertebra or above the superior end vertebra is wider on the concave side of the curve .
- Within the curve the intervertebral spaces usually are wider on the convex side and narrower on the concave side

Vertebral rotation

NASH and Moe method

- If the pedicles are equidistant from the sides of the vertebral bodies , no vertebral rotation (0 rotation)
- The grades progress up to grade IV rotation , in which the pedicle is past the center of the vertebral body .



	Pedicle Convex	Concave
Grade: Neutral	No asymmetry	No asymmetry
Grade: +	Migrates within first segment Early distortion	May start disappearing Early distortion
Grade: + +	Migrates to second segment	Gradually disappears
Grade: + + +	Migrates to middle segment	Not visible
Grade: + + + +	Migrates past midline to concave side of vertebral body	Not visible

Fig.8.18 Pedicle method of determining vertebral rotation. Vertebral body is divided into six segments and grades from 0 to 4+ are assigned, depending on location of pedicle within segments. Because pedicle on concave side disappears early in rotation, pedicle on convex side, easily visible through wide range of rotation, is used as standard.

Curve patterns (Ponscti , Friedman , Moe) .

Six curve patterns :

1- Single major lumbar curve its apex between the L1 – L2 disc and L4.
2- Single major thoraco – lumbar curve apex is at T12 or L1.
3- Combined thoracic and lumbar curve (Double Major Curve).
   Generally cause less vissible deformities because the curves are nearly the same degree in size and the trunk usually is will balanced .

4- Single major thoracic curve
   - usually RT convex pattern
   - Rotation is obvious .
5- Single major high thoracic curve Apex at T3 . the curve extending from C7 or T1 to T4 or T5
6- Double major thoracic curve short upper thoracic curve , often extending from T1 to T5 or T6
   - Considerable rotation .
   - Combination with lower thoracic curve extending from T6 to T12 or L1.

The Risser radiographic classification of the skeletal maturity is based on the ossification pattern of the iliac crest epiphysis .

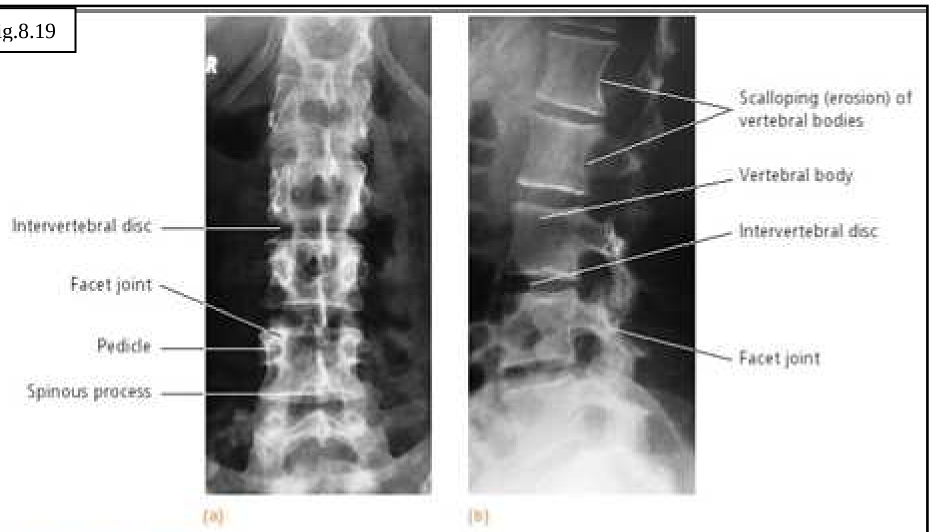
- Ossification occurs from the anterior superior iliac spine to the posterior superior iliac spine
- Excursion of ossification is divided into four grades :
- Risser 1 : 25% excursion .
- Risser 2 : 50% excursion .
- Risser 3 : 75% excursion .
- Risser 4 : 100% excursion .(Complete excursion)
- Risser 5 : Fusion of the epiphysis to the ilium representing the end of spinal growth .

The Back

❖ ***Plain X-Ray:***

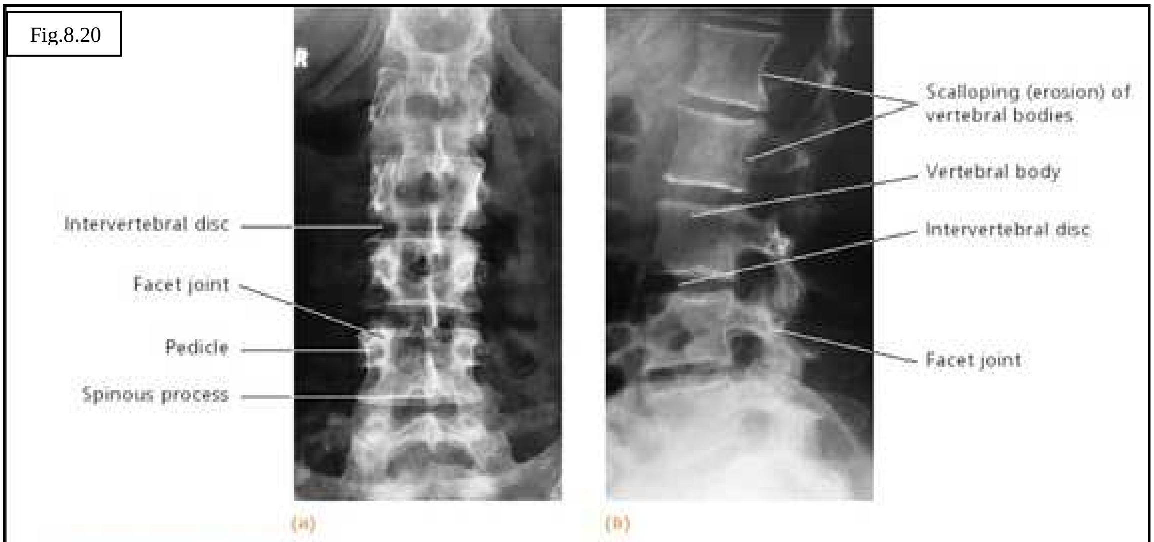
Begin with anteroposterior and lateral views of the spine; for the lumbar region, oblique views of the spine, an anteroposterior x-ray of the pelvis and a postero- anterior view of the sacroiliac joints may also be needed.
In the anteroposterior view the spine should look perfectly straight and the soft-tissue shadows should outline the normal muscle planes. Curvature (scoliosis) is obvious, and best shown in erect views. Bulging of the psoas muscle or loss of the psoas shadow may indicate a paravertebral abscess. Individual vertebrae may show alterations in structure, e.g. asymmetry or collapse. Check the outlines of the pedicles, which normally look like oval footprints near the lateral edges of each rectangular vertebral body: a missing or misshapen pedicle could be due to erosion by infection, a neurofibroma or metastatic disease.
In the lateral view the normal thoracic kyphosis (up to 40 degrees) and lumbar lordosis should be regular and uninterrupted. Anterior shift of an upper segment upon a lower (spondylolisthesis) may be associated with defects of the posterior arch, which show best in
oblique views. Vertebral bodies, which should be rectangular, may be wedged or biconcave, deformities typical of osteoporosis or old injury. Bone density and trabecular markings also are best seen in lateral films. Lateral views in flexion and extension may reveal excessive intervertebral movement, a possible cause of back pain.
The intervertebral spaces may be edged by bony spurs (suggesting longstanding disc degeneration) or bridged by fine bony syndesmophytes (a cardinal feature of ankylosing spondylitis).
The sacroiliac joints may show erosion or ankylosis, as in tuberculosis (TB) or ankylosing spondylitis, and the hip joints may show arthrosis, not to be missed in the older patient with backache.

Fig.8.19



Lumbar spine x-rays (a,b) The most important normal features are demonstrated in the lower lumbar spine. In this particular case there are also signs of marked posterior vertebral body and facet joint erosions at L1 and L2, features that are strongly suggestive of an expanding neurofibroma.

Fig.8.20



Lumbar spine x-rays (a,b) The most important normal features are demonstrated in the lower lumbar spine. In this particular case there are also signs of marked posterior vertebral body and facet joint erosions at L1 and L2, features that are strongly suggestive of an expanding neurofibroma.

The Risser radiographic classification of the skeletal maturity:

The Risser radiographic classification of the skeletal maturity is based on the ossification pattern of the iliac crest epiphysis. Ossification occurs from the anterior superior iliac spine to the posterior superior iliac spine.

- Excursion of ossification is divided into four grades :

  - ***Risser 1*** : 25% excursion .
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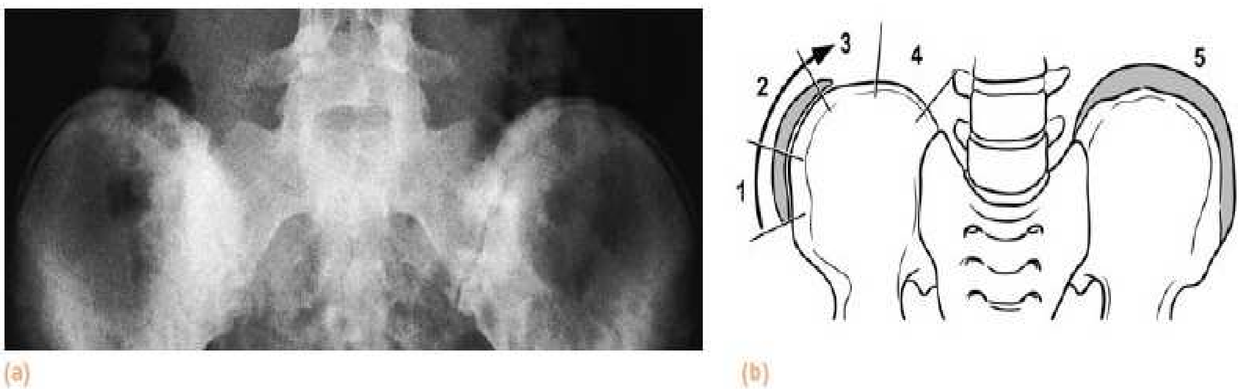
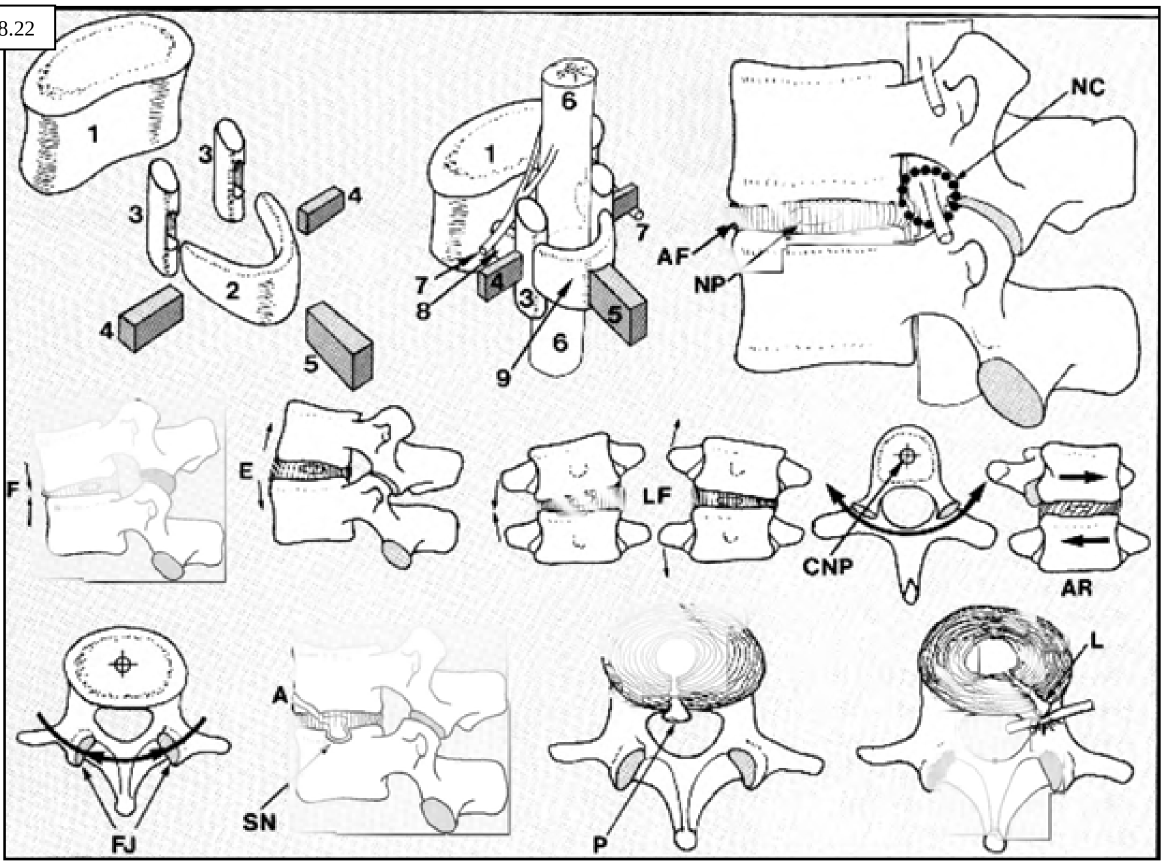


Fig.8.21

Risser's sign The iliac apophyses normally appear progressively from lateral to medial (stages 1–4). When fusion is complete, spinal maturity has been reached and further increase of curvature is negligible (stage 5).

Fig.8.22



<u>The spine:</u> *anatomical features:*

The complex relationship of the components of the typical vertebra may be illustrated by exploded diagram (shown here after Kapandji). The bony elements comprise the vertebral body (1), composed of cancellous bone covered with an outer shell of cortical bone, the horseshoe-shaped neural arch (2), two articular masses or processes (3) which take part in the facet (interarticular) joints, the transverse processes (4), and the spinous processes (5).

When these components are brought together they form a protective covering for the cord (6) and issuing nerve roots (7). The neural arch (2) is divided by the articular processes (3) into pedicles (8) and laminae (9).

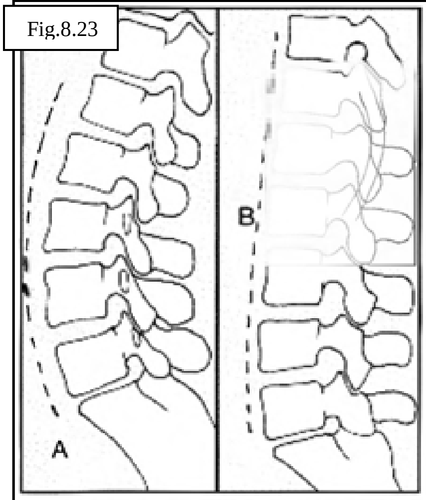
Each vertebra articulates with the one above and below by means of the facet joints and the intervertebral discs. Each disc, lying between the hyaline cartilage end-plates of adjacent vertebral bodies, is composed of a nucleus pulposus (NP) surrounded by concentric sheets of fibrous tissue (annulus fibrosis) (AF).

Movement between the vertebrae are possible in several planes, and the axes of these movements pass through the approximate centers of the intervertebral discs. At all levels of the spine, flexion (F) and extension (E), and lateral flexion (LF) to both sides are possible. In the thoracic spine, the plane of the facet joints lies in the arc of a circle which has its centre in the nucleus pulposus (CNP); as a result, (axial) rotation (AR) is possible in this part of the spine. In contrast, the orientation of the facet joints (FJ) in the lumbar region is such that rotation is blocked, i.e. *virtually no vertebral rotation occur in the lumbar spine.*

As a result of the elasticity of annulus, the nucleus pulposus is under constant pressure, and may (uncommonly) herniated into a vertebral body anteriorly (A) or centrally (Schmorl's node) (SN). A much more common occurrence is for the annular fibers to tear (as a result of trauma or degenerative changes) so that the nucleus bulges

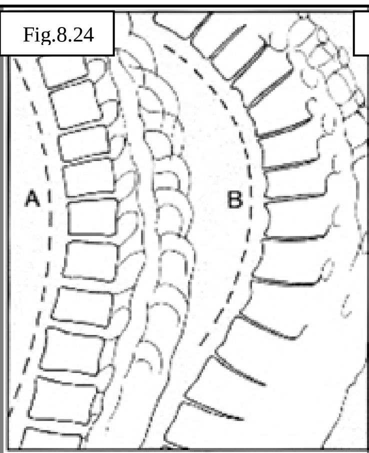
posteriorly (P) or laterally (L): “slipped disc”- central or lateral protrusions. A posterior (central) disc protrusion may affect the cord directly (or the cauda equine in the lower lumbar spine): this may lead to bilateral lower limb signs with or without bladder involvement. With lateral protrusions, the neurological disturbance usually result from pressure on one or two nerve roots only- so that the effects are more localized and usually predominate on one side. In the neural canals (NC, circled, top right) the space for the segmental nerves is restricted, and in this region symptoms may be caused not only by a disc prolapsed, but by any pathology in the neural canals (e.g. arthritic facet joint lipping).

Fig.8.23



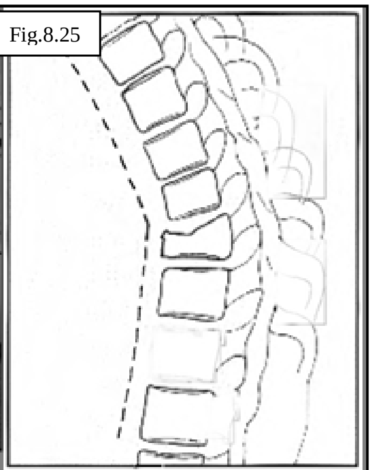
Radiographs (3): In the lateral, note first the lumbar curve: (A) typical normal; (B) loss of lordosis (most often seen in prolapsed intervertebral disc as a result of protective muscle spasm, but not confirmatory).

Fig.8.24



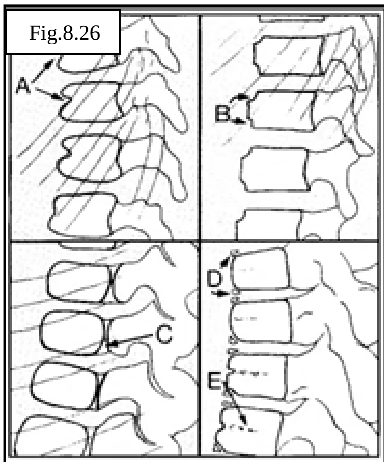
Radiographs (4): In the thoracic spine note (A) a typical normal curve; (B) an increased but regular curve typical of senile kyphosis. Scheuermann's disease is another frequent cause of a regular dorsal kyphosis. Kyphosis may be measured on the radiographs with the technique for assessing scoliosis (see later). *45° is taken as the upper limit of normal.*

Fig.8.25



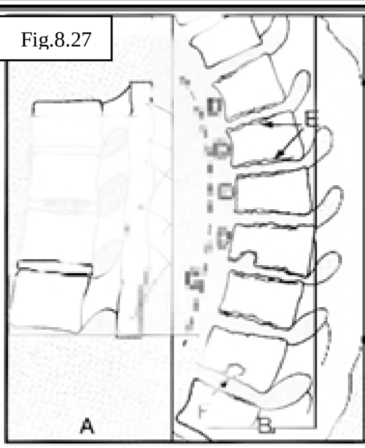
Radiographs (5): In both the lumbar and the thoracic spine note any sharp alteration in the curvature (angular kyphosis), found typically where there is pathology restricted to one or two vertebral bodies, e.g. from fractures, TB or other infections, tumour, osteoporosis and osteomalacia with local vertebral body collapse.

Fig.8.26



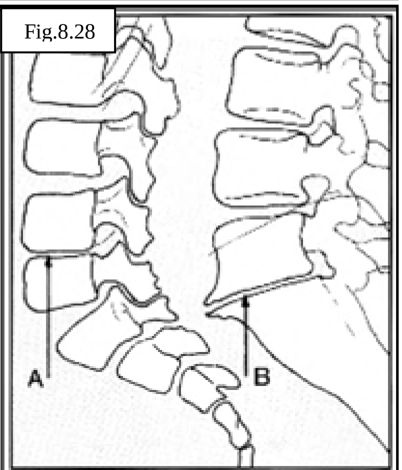
Radiographs (6): Now look at the shape of the bodies and the size of the discs. Compare with the bodies and disc spaces above and below. The following are normal in the child's spine: (A) anterior clefts, (B) anterior notches, (C) incomplete fusion of elements, (D) epiphyses, (E) vascular tracks (which may persist).

Fig.8.27



Radiographs (7): Note (A) disc calcification; (B) the typical appearance of Scheuermann's disease, with (C) kyphosis, (D) anterior wedging of not less than 5° involving at least three sequential vertebrae, (E) ragged appearance of the epiphyses. Note (F) a central disc herniation (Schmorl's node); this is not always associated with Scheuermann's disease.

Fig.8.28



Radiographs (8): Note (A): disc narrowing at any level in the spine is the earliest evidence of tuberculosis and other infections; (B) Narrowing at L5–S1 and, less commonly, in the two spaces above occurs in long-standing disc lesions and is often associated with anterior lipping.

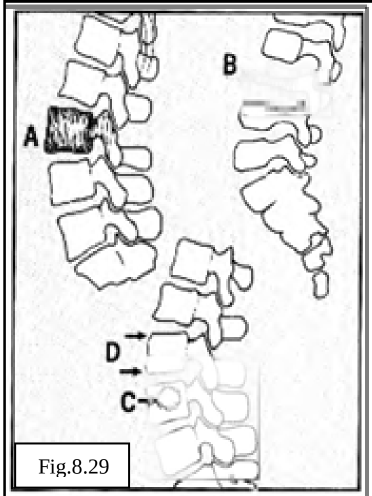


Fig.8.29

Radiographs (9): Note (A) increased density and the 'picture-frame' appearance of the vertebral bodies in Paget's disease; (B) marked narrowing and increased density seen in Calvé's disease (vertebra plana); (C) any space-occupying lesion in a vertebral body (usually due to tumour or infection (but note Schmorl's nodes)); (D) corner vertebral erosions (Romanus lesions), seen in ankylosing spondylitis.

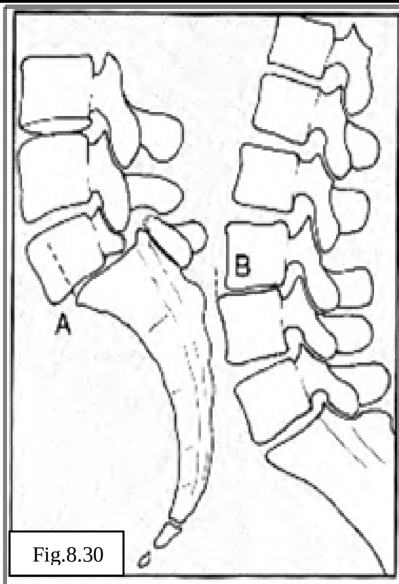
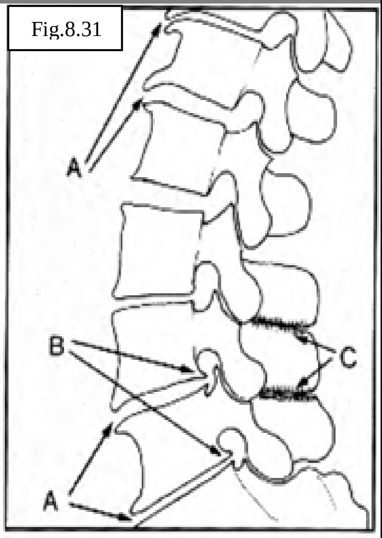


Fig.8.30

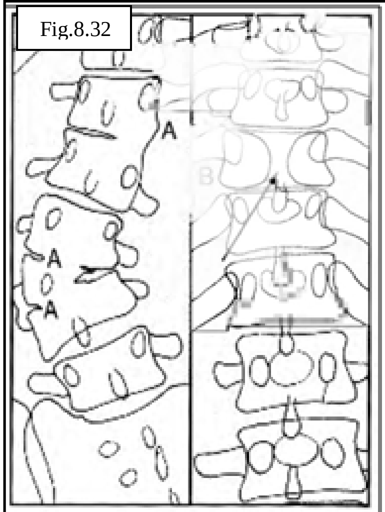
Radiographs (10): Note the relationship of each vertebra to its neighbour. In particular, note (A) spondylolisthesis (see also later); (B) retrospondylolisthesis (usually associated with disc degeneration).

Fig.8.31



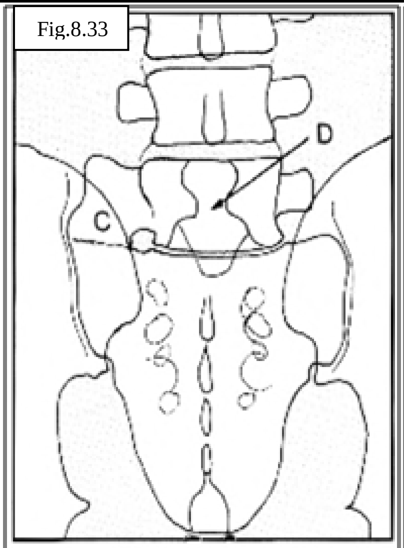
Radiographs (11): Lipping is seen in chronic disc lesions, mainly at L5–S1, but also at the other rarer disc prolapse sites. Note (A) anterior lipping; (B) posterior lipping. Lipping is also the main feature (at all levels) of osteoarthritis. Note (C) impingement of spinous processes ('kissing spines').

Fig.8.32



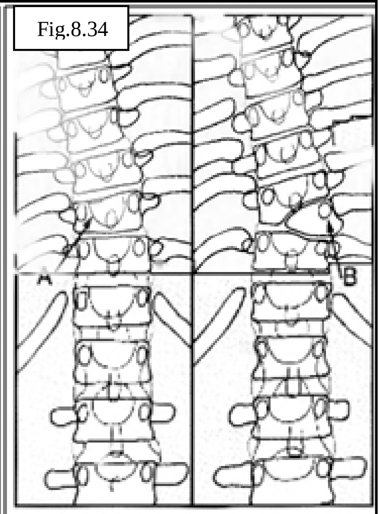
Radiographs (14): In the anteroposterior view note the presence of any congenital abnormalities, such as (A) congenital vertebral fusion, often associated with a congenital scoliosis; (B) anterior spina bifida, in which there is failure of fusion of the vertebral body elements (this is usually symptom free).

Fig.8.33



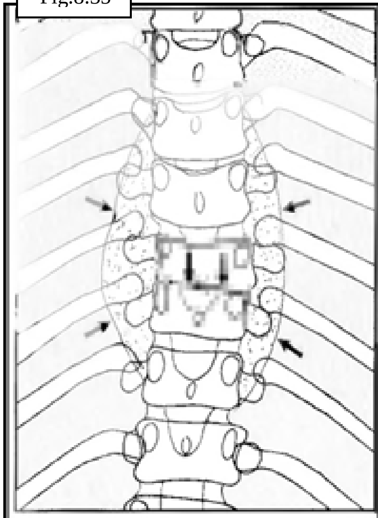
Radiographs (15): Note also any anomalies of the lumbosacral articulation, such as (C) partial sacralization of the fifth lumbar vertebra, a possible cause of low back pain. Note also (D) the presence of (posterior) spina bifida.

Fig.8.34



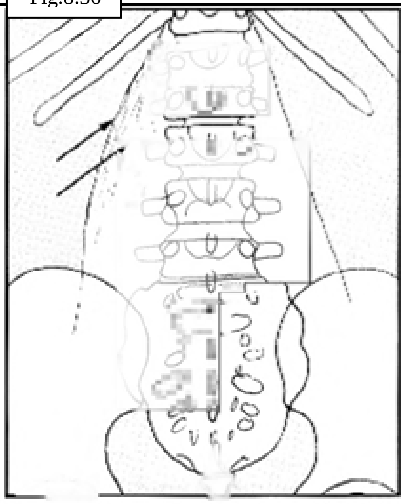
Radiographs (16): Note (A) the presence of any localized lateral angulation of the spine due to lateral vertebral collapse, e.g. from fracture, infection, tumour, osteoporosis or other causes; (B) hemivertebra, a common cause of congenital scoliosis (note that, as illustrated, this is usually associated with an extra rib).

Fig.8.35



Radiographs (17): Look at the soft tissue shadows at the sides of the vertebrae, observing, for example, the fusiform increased density typical of a tuberculous abscess. Note disc obliteration and early lateral wedging.

Fig.8.36



Radiographs (18): Examine the psoas shadows for symmetry. Lateral displacement of the edge of the shadow, and increased density within the main area occupied by psoas, suggests a psoas abscess, typically found in tuberculosis of the lumbar or lowermost thoracic spine.

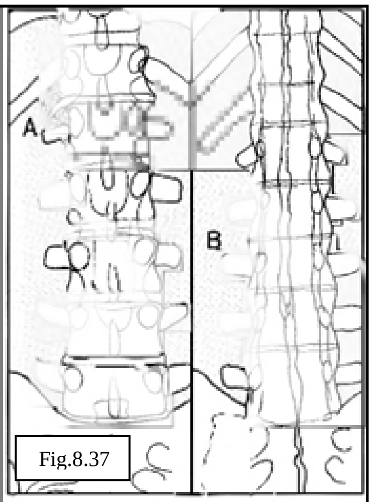
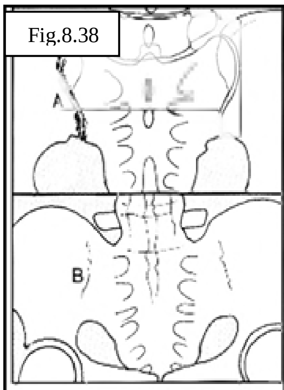


Fig.8.37

Radiographs (19): Look for lateral lipping, (A); at D12–L1 it may be an early sign of ankylosing spondylitis, but there and elsewhere it usually indicates osteoarthritis. 'Bamboo spine' (B) is diagnostic of ankylosing spondylitis. Note any body and facet joint fusions and ligament calcification.

Fig.8.38



Radiographs (20): Look at the sacroiliac joints. (A) Unilateral involvement (sclerosis, cystic changes or obliteration) may occur in tuberculosis and other infections. Any asymmetry should be investigated by oblique projections and, if necessary, tomography or CT scans. Bilateral involvement (B) is common in ankylosing spondylitis, and should always be sought when this condition is suspected.

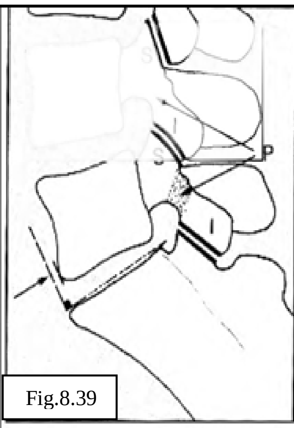


Fig.8.39

Radiographs (22): Look for evidence of spondylolisthesis. In the normal spine the pars interarticularis (P) lying between (S) the superior and (I) the inferior articular facets is intact, and a vertical raised from the anterior margin of the sacrum lies in front of L5.

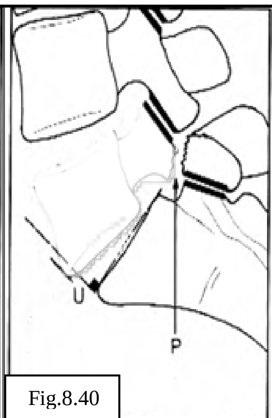


Fig.8.40

Radiographs (23): If spondylolisthesis is suspected, the lateral should always be taken with the patient standing. Note any defect (P) and any forward slip (U). The deformity may occur between L5 and S1, and much less frequently between L4/L5 or L3/L4.

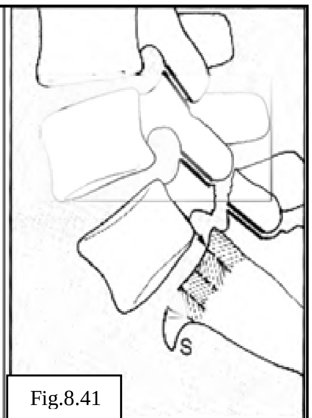
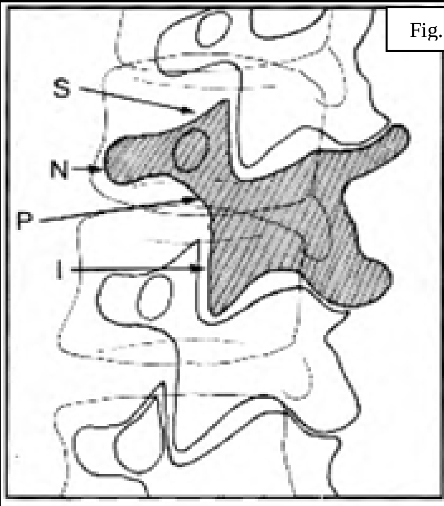


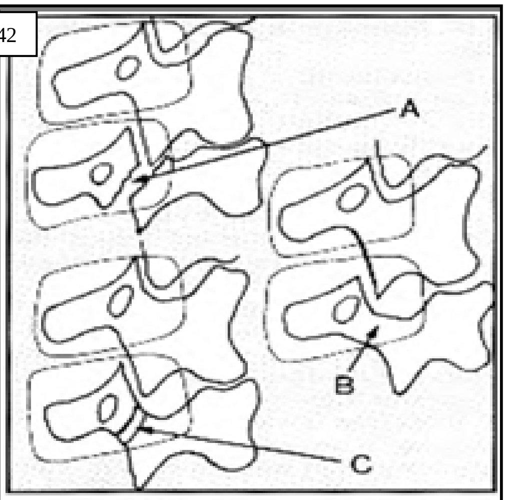
Fig.8.41

Radiographs (24): Note that (S) new bone formation (buttressing), if present, may make use of the anterior edge of the sacrum as a reference unreliable. Instead, note the relationship between the *posterior* edge of the slipping vertebra to the one below. The example shows a forward slip of 25%.

Fig.8.42



Radiographs (26): Oblique views are invaluable, provided they are taken in the plane of any defect. In interpreting these, identify the 'Scotty dog' shadows (shown dark grey and hatched). The nose (N) is formed by a transverse process; the ear (S) by a superior articular process; the front legs (I) by an inferior articular process; the neck (P) by the pars interarticularis.



Radiographs (27): In spondylolisthesis (A) the 'dog' becomes decapitated owing to forward slip, and the inferior articular process of the vertebra above encroaches on the neck. In spondylolysis, where no slip has occurred, the neck (B) is elongated or (C) develops a collar. CT scans can also be of value provided the so-called gantry angle of the projection is at right-angles to the plane of the table.

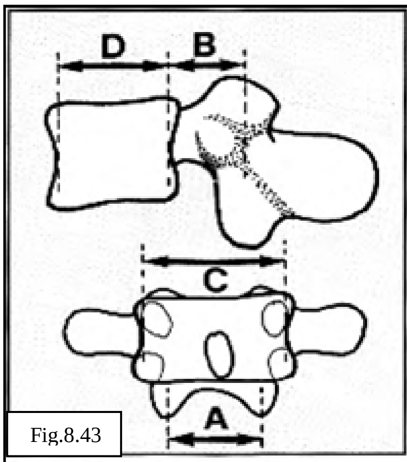


Fig.8.43

. **Radiographs (28):** Where spinal stenosis is suspected, calculate the canal to body ratio, A × B:C × D, where A = interpedicular distance, B = spinal canal front-to-back (measured to the root of the spinous process), C = width of vertebral body, D = body, front-to-back. The normal range is from approximately 1:2–1:4.5. Values greater than 4.5 suggest spinal stenosis, but CT scans are of particular value in clarifying the site and extent of any narrowing.

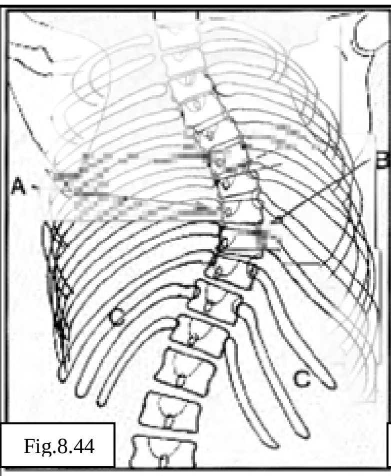


Fig.8.44

. **Radiographs (29):** Note the presence of any structural scoliosis. This is associated with rotation of the vertebral spines towards the concavity (A), and narrowing of pedicles. On the convexity of the curve there is widening of disc spaces (B). In the thorax, there is ribcage distortion, (C). Identify the primary curves clinically, or by assessing absence of movement in lateral flexion radiographs.

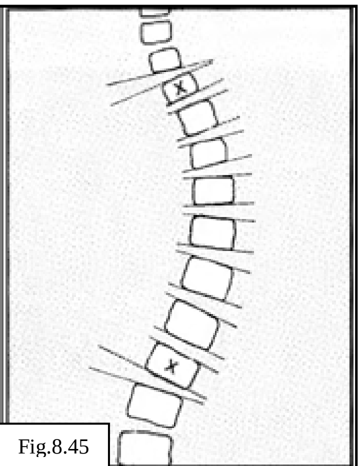
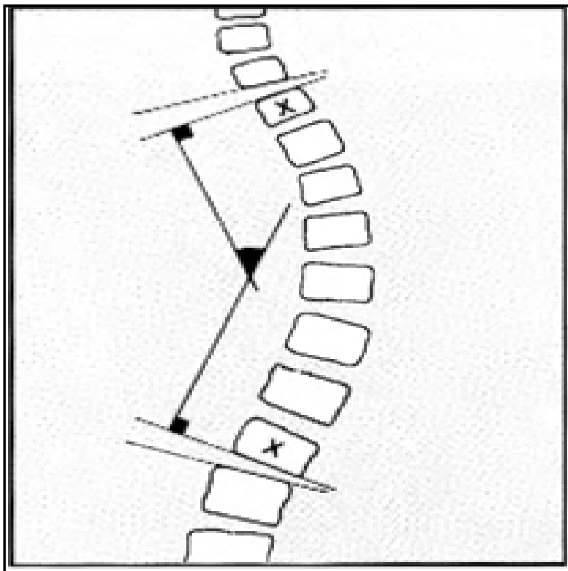
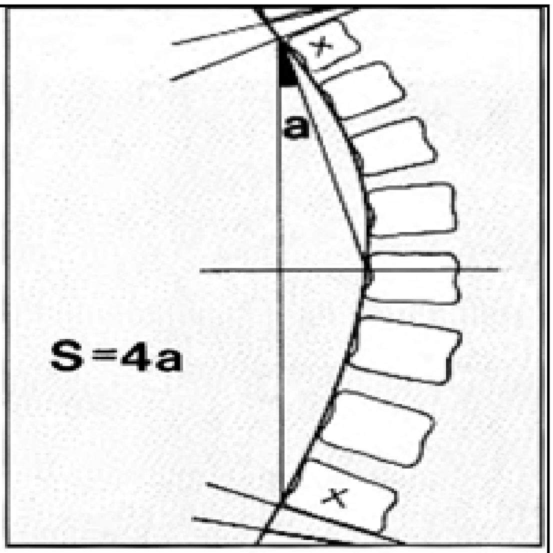


Fig.8.45

Radiographs (30): To assess the severity of a scoliotic curve, and to allow its progress to be monitored it is necessary to measure the deformity. The Cobb method is most popular, although it is difficult to obtain consistent results with it. First, find the upper and lower limits of the primary curve by drawing tangents to the bodies and noting where the disc spaces begin to widen on the concavity of the curve.



. **Radiographs (31):** Now erect perpendiculars from the vertebrae that form the limits of the curve (marked 'X'). Note the angle between them. This is a measure of the primary curve, and can be used for comparison with past and future radiographs. Kyphotic curves may be measured in a similar way. Any decision regarding treatment *must* take into account the clinical picture, and not rely on the radiographs alone.



Radiographs (32): Capasso's method of measuring scoliotic curves is said to be more sensitive and accurate. The magnitude of the scoliotic curve (S) in degrees is obtained by multiplying by 4 the angle (a) subtended by a line joining the ends of the curves, with one running from the centre of the curve to one end of the curve: i.e. S = 4a. Again, note that in any case of suspected idiopathic scoliosis an MRI scan is mandatory to exclude syringomyelia, which is said to occur in 25% of cases.

The Hip

Pain:

- In the groin.
- In the front of the thigh.
- In the knee.
- Pain in the knee occasionally is the only symptom.
- Pain in the back of the hip usually from lumbar spine.

Limp:

- Due to pain.
- Limb shortening.
- Muscle weakness (abductors).
- Joint instability (subluxation or dislocation).

Snapping or Clicking:

- Slipping of gluteal maximus tendon over the greater trochanter.
- Detachment of the acetabular laburum.
- Psoas bursitis.

Stiffness and Deformity:

Inspection:

Gait:

- ***Trendeleburg's gait:*** Causes:
  a) Pain on weight-bearing.
  b) Weakness of the hip abductors.
  c) Shortening of the femoral neck.
  d) Dislocation or subluxation of the hip.
- ***Antalgic gait:*** An irregular limp, with the patient moving more quickly off the painful side.
-

Atittude: The rest position of the hip.

- *Flexion hip.*
- *Abduction hip.*
- *External rotation hip.*
- *Flexion knee.*

Fig.9.1

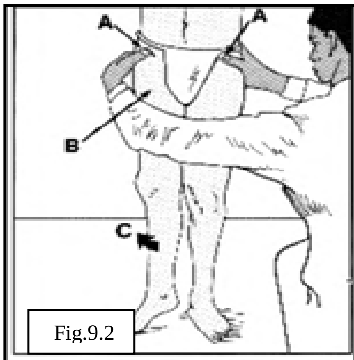
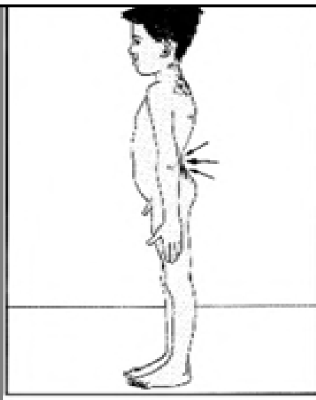
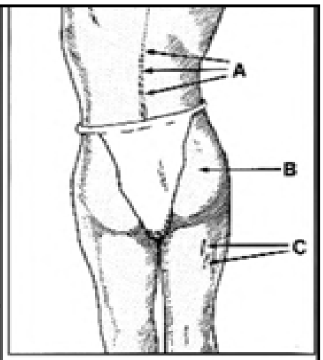


Fig.9.2

Inspection (1): Examine the standing patient from the front. Note (A) any pelvic tilting (e.g. from adduction or abduction deformity of the hip, short leg, scoliosis), (B) muscle wasting (e.g. secondary to infection, disuse, polio), (C) rotational deformity (common in osteoarthritis).



Inspection (2): Examine the patient from the side. Note any increased lumbar lordosis suggestive of fixed flexion deformity of the hip(s).



Inspection (3): Look at the patient from behind. Note (A) any scoliosis (possibly secondary to pelvic tilting from, for example, an adduction deformity of the hip), (B) gluteal muscle wasting (e.g. from disuse, infection), (C) sinus scars (e.g. secondary to tuberculosis).

Fig.9.3

Movement (a) Forcing one hip into full flexion will straighten out the lumbar spine; the other hip should still be capable of full extension in this position. (b) Now the position is reversed; the right hip is held in full flexion. (c) If the hip cannot straighten out completely, this is referred to as a *fixed flexion deformity*. (d) Testing for abduction. The pelvis is kept level by placing the opposite leg over the edge of the examination couch with that hip also in abduction (the examiner's left hand checks the position of the anterior spines) before abducting the target hip. (e) Testing for adduction. (f–h) External and internal rotation are assessed (f) first with the hips in full extension and then (g,h) in 90° of flexion. (i) Testing for extension.

Fig.9.4

Movement (a) Forcing one hip into full flexion will straighten out the lumbar spine; the other hip should still be capable of full extension in this position. (b) Now the position is reversed; the right hip is held in full flexion. (c) If the hip cannot straighten out completely, this is referred to as a *fixed flexion deformity*. (d) Testing for abduction. The pelvis is kept level by placing the opposite leg over the edge of the examination couch with that hip also in abduction (the examiner's left hand checks the position of the anterior spines) before abducting the target hip. (e) Testing for adduction. (f–h) External and internal rotation are assessed (f) first with the hips in full extension and then (g,h) in 90° of flexion. (i) Testing for extension.

Posture:

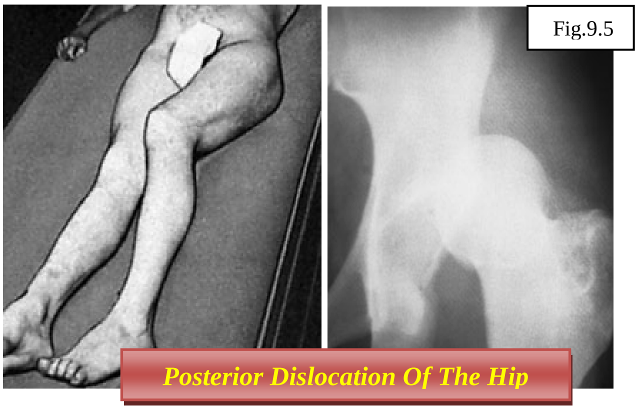
- ***Posterior dislocation:***

- *Short limb.*
- *Adducted thigh*
- *Internally rotated.*
- *Slightly flexed.*

❖ ***<u>Anterior dislocation</u>:***

- Not short (may be long) limb.
- Abducted.
- Externally rotated.
- Slightly flexed.

Fig.9.5



Posterior Dislocation Of The Hip

Fig.9.6

Anterior Dislocation Of The Hip

Shortening:
It is important in the examination of the hip and the lower limb to determine the presence or absence of shortening.

❖ ***<u>In true shortening:</u>*** the affected limb is physically shorter than the other.

- This may be caused by pathology:
  (A) *Above or proximal to the greater trochanter,*
  (B) *Distal to the trochanters.*

(A) ***<u>True shortening from causes above the trochanter include:</u>***

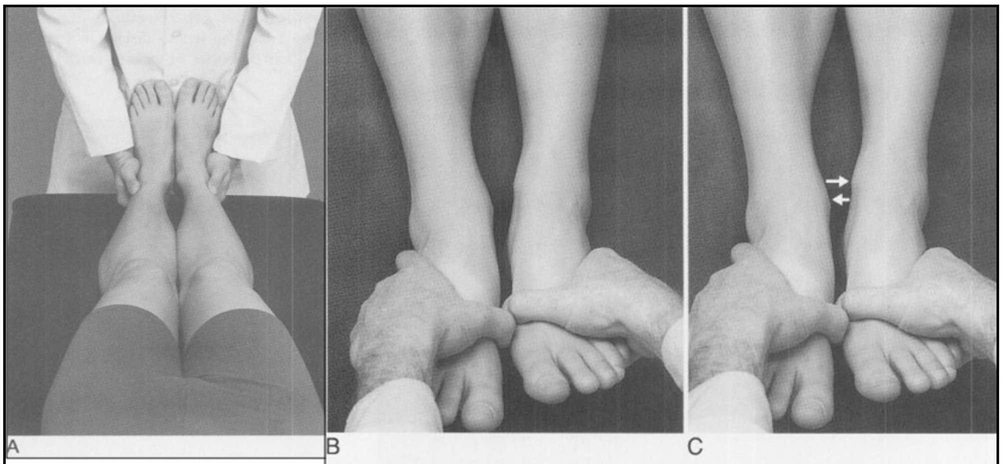
(a) Coxa vara (e.g. from neck fractures, slipped epiphysis, Perthes's disease, congenital coxa vara).
(b) Loss of articular cartilage (from infection, arthritis).
(c) Dislocation of the hip.

(B) ***<u>True shortening from causes distal to the trochanters:</u>*** most frequently result from:

(a) Old fractures of the femur.
(b) Old fractures of the tibia.
(c) Growth disturbance (e.g. from polio, bone or joint infection or epiphyseal trauma).

- Shortening_ very rarely lengthening of the other limb gives relative true shortening.
  - This may be due to:
    A) Stimulation of the bone growth from increased vascularity (e.g. after long bone fracture in children, or bone tumour).
    B) Coxa valga (e.g. following polio).

- ***<u>In apparent shortening:</u>*** the limb is not altered in length, but appears short as a result of an adduction contracture of the hip which has to be compensated for by tilting of the pelvis.
  - Limb shortening may be compensated by:
    A) Plantar-flexion of the foot on the affected side, or by
    B) Flexion at the knee on the other, or
    C) By pelvic tilting which in turn may be compensated by the development of a lumbar scoliosis.



Visual method for evaluation of leg length discrepancy.
A- Technique.
B+C- Comparing medial malleoli.

Fig.9.7

Shortening: Examination

- The patient should be adjusted to lie squarely on the couch, with the trunk and the legs parallel to its edge.
- The position of the pelvis should be observed (by the position of the anterior superior iliac spines) and adjusted where possible.
- In the normal patient the heels should be level, and the plane of the spines at right angles to the edge of the couch.
- Where there is significant true shortening, the heels will not be level (the discrepancy is a guide to the amount of shortening) and the pelvis will not be tilted.
- The site and amount of shortening must now be further investigated.
- Begin by hooking the thumbs under the anterior spines. Fell for greater trochanters with the finger.
    - ➢ if the distance between the thumb and the fingers is shorter on one side; this suggests that the pathology lies above the trochanters.
- If in the last test there was no evidence of shortening above the trochanter, look for causes below the trochanter.
- Slightly flex both knees and hips, and place a hand behind the heels to check that you now have them squarely together.
- The position of the two knees should be compared: →(Galeazi test)
  (**A**) This appearance suggests femoral shortening.
  (**B**) This appearance suggestive of tibial shortening.

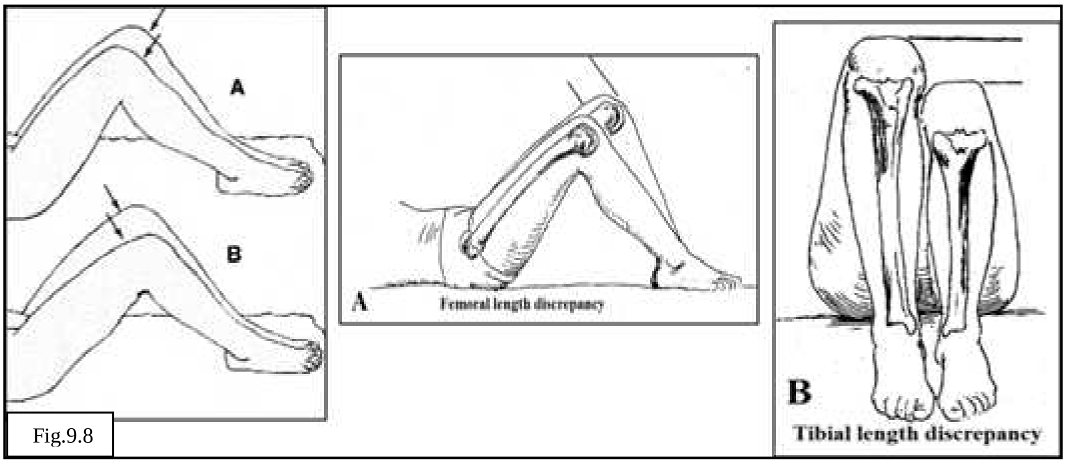


Fig.9.8

- Further confirmation of tibial shortening may be made by direct measurement.
- Flex the knees and mark the line of the knee joint.
- Now measure from the mark to the tip of the medial malleolus.
- Compare the two sides.
- Any difference indicates the tibial shortening.
- Note also any obvious tibial irregularity suggestive of old fracture.

- Measurement of femoral shaft shortening can only be attempted in the thin patient where the tip of the greater trochanter is easily palpable.
- Measure from the trochanter to the lateral joint line and compare the sides.

- Measurement of total (true) leg shortening is the most valuable single assessment, although it gives itself no indication of site.
- Place the metal end of the tape over the anterior spine and press it backwards until it hooks under its inferior edge.
- Now measure to the middle or inferior border of the medial malleolus.
- Compare the sides, and always repeat the measurements until consistency is obtained. Deformity of the pelvis (which is rare) may sometimes lead to errors in assessment.
- Pelvic tilting which is uncorrectable, with heel discrepancy indicates apparent shortening of the limb.
- It may of course be accompanied by some true shortening.
- The discrepancy at the heels is a measure of its degree.
- Apparent shortening may also be assessed by comparing the distances between the xiphisternum and each medial malleolus.
- When there is an adduction deformity of the hip and the leg lengths are being measured to assess any accompanying true shortening. The good leg should be adducted by the same amount before commencing measurement between the anterior spines and malleoli.
- True leg shortening may also be measured by blocking up the short leg until both anterior superior iliac spines and the iliac crests lie horizontally, and the natal cleft is vertical: A further check of the pelvis being level is to see that the posterior iliac spines remain horizontal when the patient flexes forwards.
- In the difficult case, sequential radiographs of the hips, knees and ankles, taken on a single plate without moving the patient afford accurate comparison of the sides.

Limb length discrepancy. Fig.9.8 Apparent length measurement.

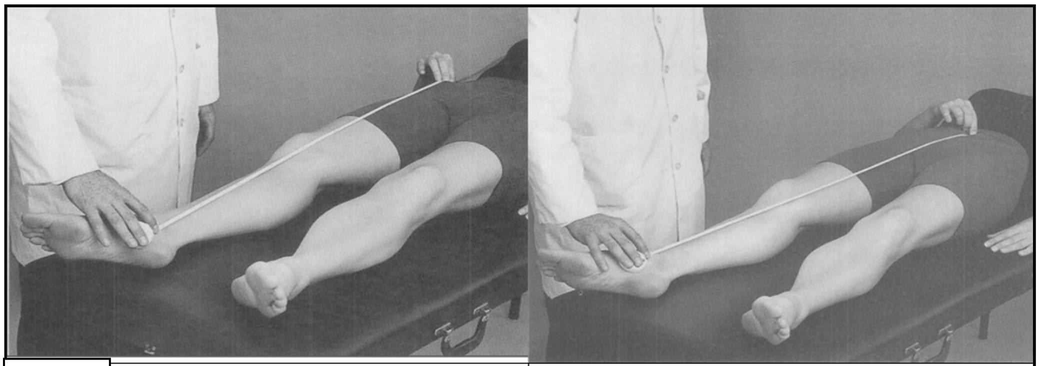


Fig.9.9 True length measurement. Apparent length measurement.

Inspection of the skin:

- Signs of inflammation.
- Sinus.
- Scar.
- Pigmentation.
- Dilated veins.
- The presence of extra skin folds (e.g. in DDH).
- Absents of the skin creases (e.g. in arthrogryposis).

Inspection of the soft tissue:

- Inguinal lymph nodes.
- Psoas abscess.
- Hernia (inguinal).
- Muscle wasting of the thigh.
- Change in the contours of the muscles (e.g. Rectus femuris rupture).

Inspection of the bones:

- Prominent greater trochanter (coxa vara).
- Prominent head of femur:
  - _ Posterior dislocation_ Posteriorly.
  - _ Anterior dislocation _ Anteriorly.
- Bowing of the femoral bone:
  - _ Rickets.
  - _ Osteogenesis imperfect.

Palpation:

(1) Place the fingers over the head of the femur below the inguinal ligament, lateral to the femoral artery.

- Note any tenderness. Now rotate the leg medially and laterally. Creptations arising in the hip joint may be detected in this way.

(2) Palpate the origin of adductor longus (body of pubis, medial to pubic tubercle).

- Tenderness occurs here in sports injuries (strain of adductor longus) and in patients developing adductor contractures in osteo-arthritis of the hip.

(3) Externally rotate the leg and palpate the lesser trochanter.

- Tenderness occurs here in strains of the ilio-psoas as a result of athletic injuries.

(4) Palpate the region of the Ischial tuberosity looking for tenderness.

- Strain of the hamstring origin occurs as a result of athletic activities, especially in children, less commonly athletic injuries may affect the anterior superior and inferior spines.

Movements:

Extension:

(1) Place a hand behind the lumbar spine so that you may assess its position.
(2) Now flex the good hip fully, observing with the hand that the lumbar curvature is fully obliterated.
(3) If the hip being examined rises from the couch, this indicates loss of extension in that hip (also described as fixed flexion deformity of the hip).
  - Any loss should be measured and recorded.
  - This test is usually referred to as ***Thomas's*** *test*.

(4) To check smaller losses of extension, especially when the other hip is normal, turn the patient over on to his face and steady the pelvis with one hand.
(5) Lift each leg and compare the range.

Normal range= **5-20^o**

A loss of extension is often the first detectable sign of effusion in the hip joint.

Flexion:

(1) The good hip is first flexed to obliterate the lumbar curve and to steady the pelvis.
  - The patient is asked to hold the leg in this position.

(2) The hip is then flexed, using a hand to check that no further pelvic movement occurs.
  - Note the range of movement.

Normal range= **120^o**

Abduction:

(1) A false impression of hip movement may be gained if the pelvis tilts during the examination, so first place the left hand on the patient's left anterior superior iliac spine.
  - Steady the other spine with the forearm.

(2) An alternative way of fixing the pelvis is to flex the other leg over the edge of the couch, and check movement of the pelvis by holding the anterior superior iliac spine on the side being examined.
(3) Now having fixed the pelvis, move the leg laterally and note the range achieved.

Normal range= **40^o**

Abduction may also be tested from a started position of 90^o hip flexion. This is of particular value in suspected osteo-arthritis of the hip or congenital dislocation.

Adduction:

(1) Ideally an assistant should lift the good leg out of the way to allow the affected leg to be adducted in full extension.

Normal range= **25^o**

(2) If an assistant is note available cross the leg being examined over the other.
  - This bring the leg being examined into slight flexion, but is sufficiently accurate under most circumstances.
  - If the hip is normal, the legs should cross about mid-thigh.

Adduction may also be tested from a starting position of 90° hip flexion.

Internal rotation at 90° flexion:

(1) Steady the flexed hip with one hand and move the foot laterally to produce internal rotation of the hip.

(2) Measure the range of internal rotation by comparing the position of the leg and the mid-line.

***Normal range*= 45°**

- Compare the sides. Loss of internal rotation is common in most hip pathology.

(3) A sensitive comparison of the sides may be made by asking the patient to hold the knees together while you move both feet laterally.

External rotation at 90° flexion:

(1) The position of the hip is the same as for testing internal rotation, but in this case the foot is moved medially.

(2) Measure external rotation in the same general way.

***Normal range*= 45°**

- External rotation becomes limited in most arthritic conditions of the hip.

(3) Comparison between the sides may be made by crossing one leg over the other.

Rotation in extension:

For a rough comparison of the sides, roll each leg medially and laterally, observing any play at the knee.

Internal rotation in extension:

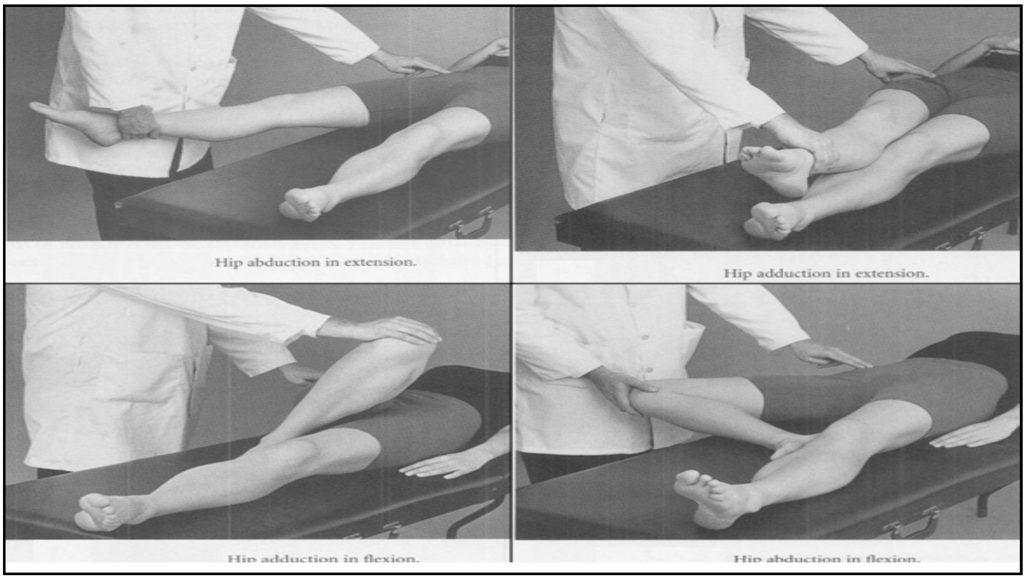
For a more accurate assessment, the patient should be prone with the knees flexed. The two sides can easily be compared and measurements taken.

***Normal range*= 35°**

External rotation in extension:

Comparison and measurement may be made in the same way.

***Normal range*= 45°**



Hip abduction in extension. Hip adduction in extension. Hip adduction in flexion. Hip abduction in flexion.

Fig.9.10

Power: Examine the power of the muscles of the thigh.

Sensation: Examine the sensation of the lower limb (dermatomal).

Reflexes: Examine the reflexes of the lower limb.

- Knee jerk= L4
- Ankle jerk= S1.

Fig.9.11

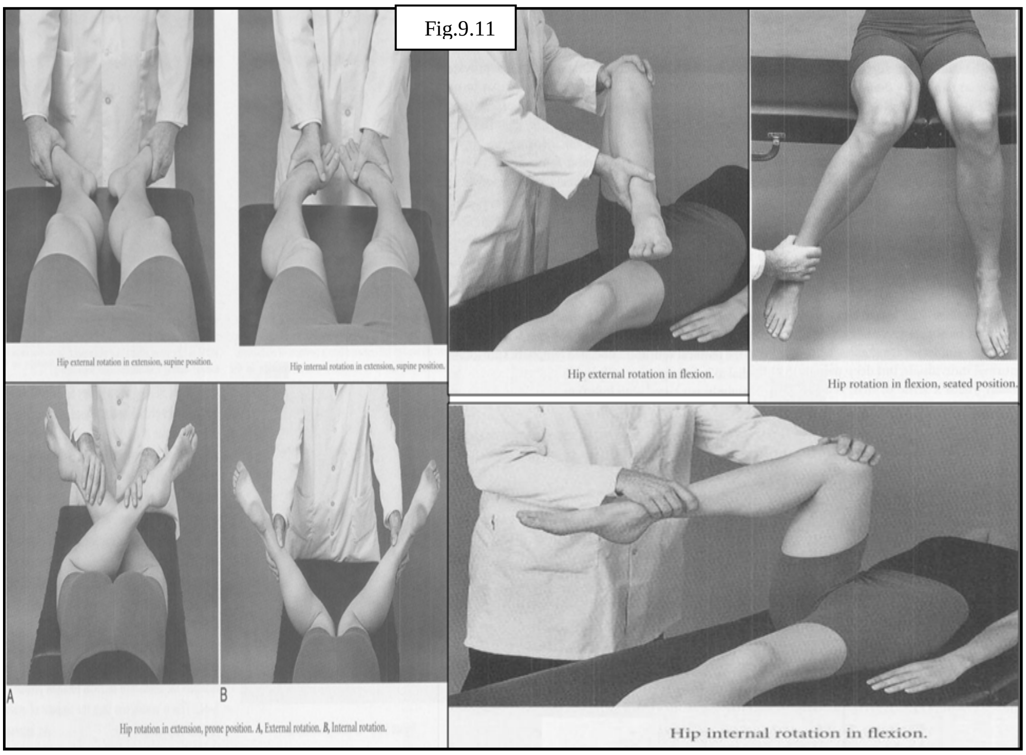
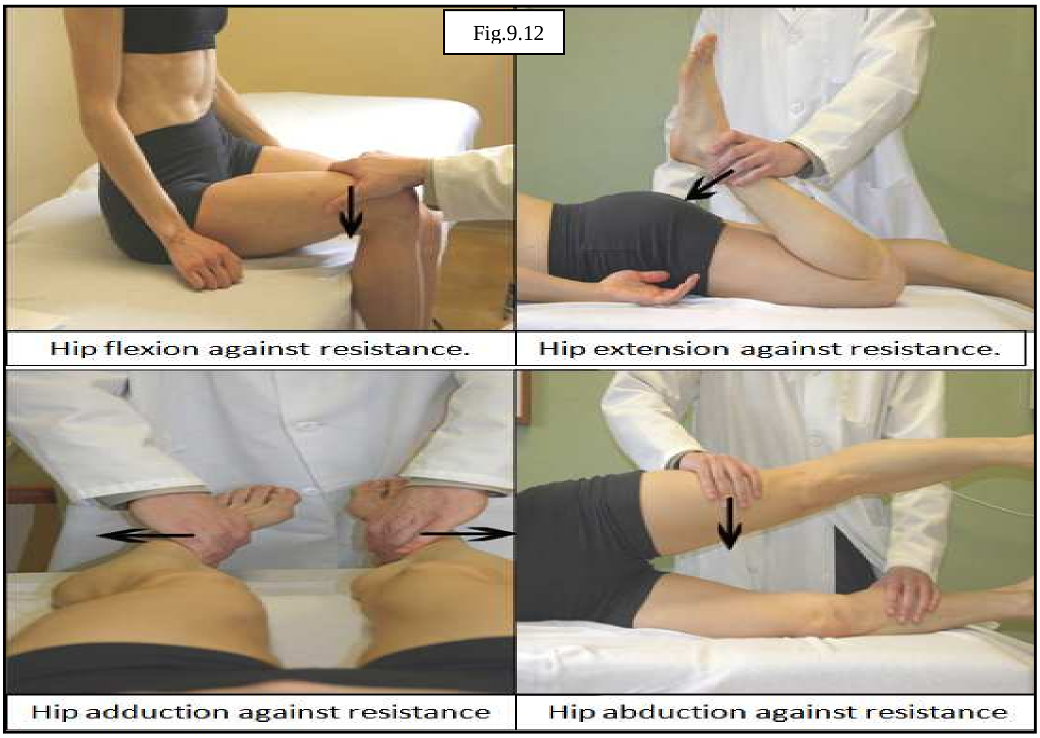


Fig.9.12



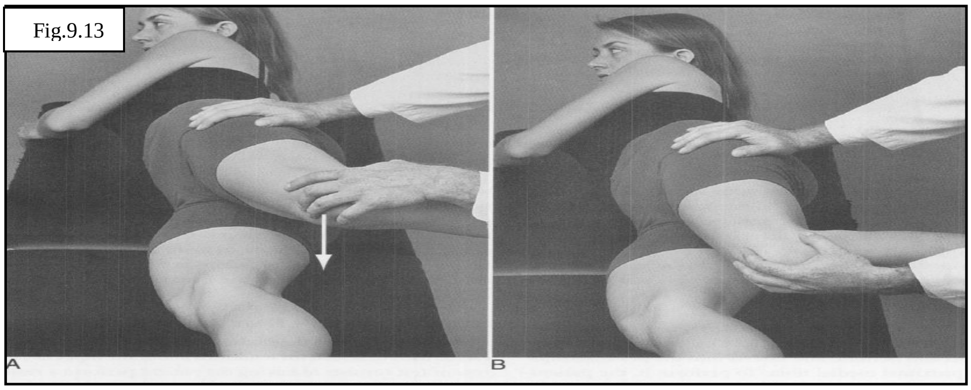
Special test:

Testing for hip fusion:

(1) When there is doubt regarding the solidity of a hip fusion. It is sometimes helpful to test for protective muscle contraction.
- Flex the good hip and knee.
- Feel for involuntary adductor contracture while suddenly abducting the leg.

(2) Repeat the test. This time feeling for flexor (ilio-psoas) contraction while making a sudden gentle attempt to extend the hip.

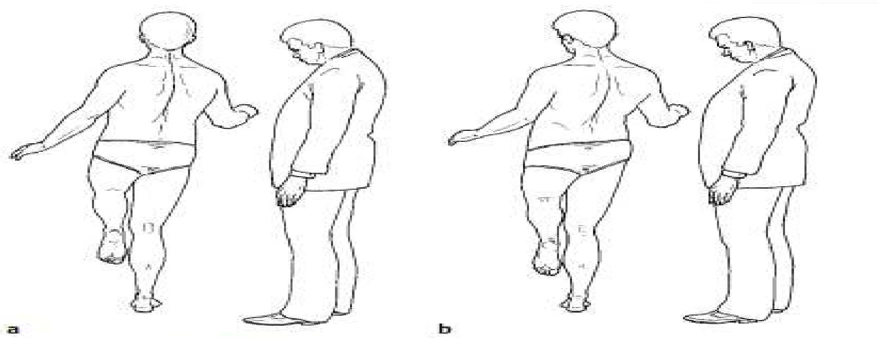
Fig.9.13



Trendelenberg's test:

(1) When standing on one leg, the centre of gravity (at S_2) is brought over the stance foot by the hip abductors (gluteus medius and minimus).
- This tilts the pelvis and normally elevates the buttock of the non-stance side.
- The patient should be able to produce a greater pelvic tilt (by being asked to lift the side higher), and hold the position for 30 seconds.

(2) Ask the patient to stand on the affect side; any support (stick or hand) must be on the same side.
- Now ask him to raise the non-stance leg further.
- Prevent excessive trunk movements (a vertical dropped from C_7 should not fall beyond the foot).



Trendelenburg sign:
a normal,
b abnormal with insuf•ciency of the gluteal muscles

Fig.9.14

- ➢ If the pelvis drops below the horizontal or cannot be held steady for 30 seconds, the test is positive.
- ➢ It is not valid below the age 4, pain, poor co-operation or bad balance may give a false positive.

(3) The test is positive as a result of:

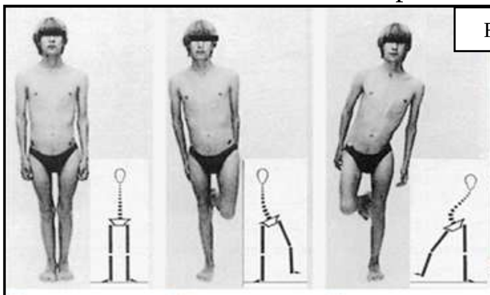
A- gluteal paralysis or weakness (e.g. from polio, muscle-wasting disease).

B- gluteal inhibition (e.g. from pain raising in the hip joint).

C- from gluteal inefficiency from Coxa vara.

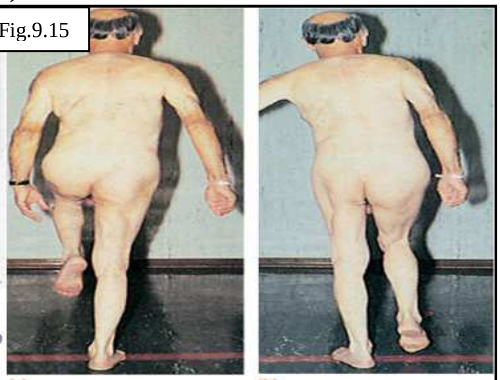
D- CDH. (Nevertheless false positives have been recorded in about 10% of patients).

Fig.9.15



(a) (b) (c)

Trendelenburg's sign (a) Standing normally on two legs. (b) Standing on the right leg which has a normal hip whose abductor muscles ensure correct weight transference. (c) Standing on the left leg whose hip is faulty, and so abduction cannot be achieved; the pelvis drops on the unsupported side and the shoulder swings over to the left.



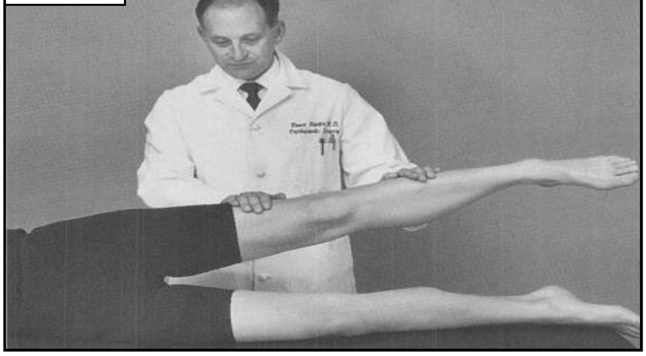
(a) (b)

Trendelenburg's test This man has a positive Trendelenburg sign on the left due to osteoarthritis of the hip. (a) He can steady himself perfectly well when balancing on the right hip; (b) when he attempts to stand on the left hip, his pelvis dips and the right buttock drops.

Gluteal muscles:

- Test the power of the abductors of the hip with the patient lying on the side, attempting to abduct the leg against resistance.
- Test the power in gluteus maximus by asking the patient to extend the hip against resistance, at the same time feeling the tone in the contracting muscle.

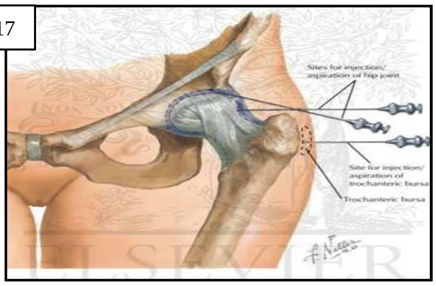
Fig.9.16



Aspiration:

- The hip may be aspirated by inserting a needle above the trochanter, allowing for femoral neck anteversion.
- Alternatively, a needle may be passed into the joint from infront, a little below the inguinal ligament and lateral to the femoral artery.

Fig.9.17



Ortolani's test:

(1) To be of any value the examination must be carried out on a relaxed child, preferably after feeding.

- ➢ Flex the knees and encircle them with the hands so that the thumbs lie along the medial sides of the thighs and the fingers over the trochanters.

(2) Now flex the hip to a right angle, and starting from a position where the thumbs are touching, smoothly and gently abduct the hips.

(3) If a hip is dislocated, as full abduction is approached the femoral head will be felt slipping in to the acetabulum.

- ➢ An audible click may accompany the displacement but in no way must this be considered an essential element of the test.
- ➢ Note that restriction of abduction may be pathological, and represent an irreducible dislocation.

Fig.9.18

Developmental dysplasia of the hip (DDH) – early signs Position of the hands for performing Ortolani's test.

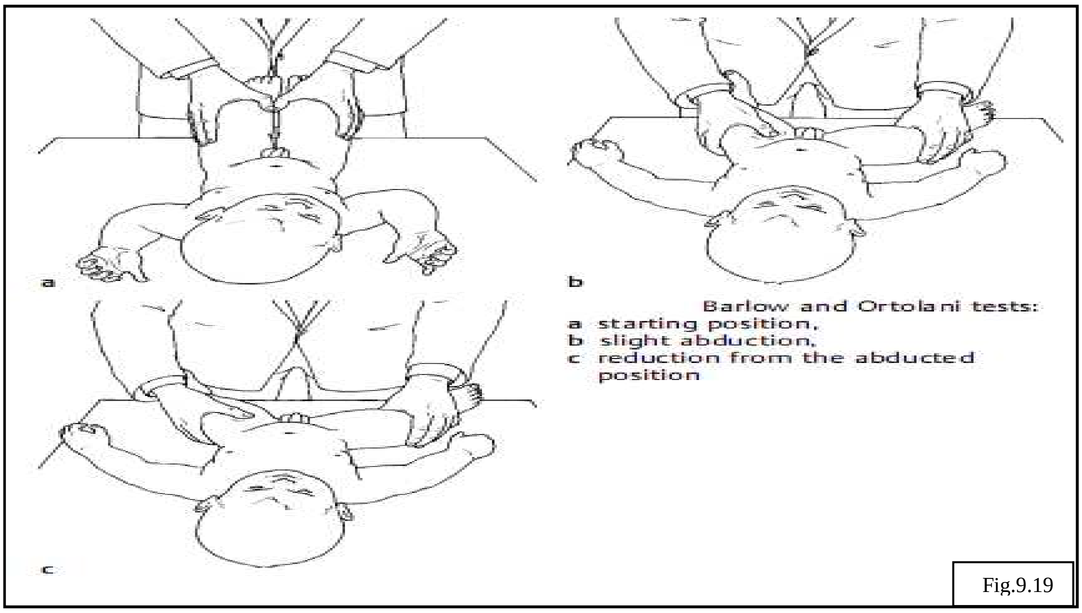
Barlow's provocative test:

(1) If the Ortolani's test is negative the hip may nevertheless be unstable

- ➢ Fix the pelvis between symphysis and sacrum with one hand, with the thumb of the other attempt to dislocate the hip by gentle but firm backward pressure. Check both sides.

(2) If the head of the femur is felt to sublux backwards, its reduction should be achieved by forward finger pressure or wider abduction.

- The movement of reduction should also be appreciated with the fingers.
- If either test is positive, treatment is essential.



Barlow and Ortolani tests:
a starting position,
b slight abduction,
c reduction from the abducted position

Fig.9.19

The Hip

Plain x-rays:

The minimum required is an anteroposterior x-ray of the pelvis showing both hips and a lateral view of each hip separately. The two sides can be compared: any difference in the size, shape or position of the femoral heads is important. With a normal hip Shenton's line, which continues from the inferior border of the femoral neck to the inferior border of the pubic ramus, looks continuous; any interruption in the line suggests an abnormal position of the femoral head. Narrowing of the joint 'space' is a sign of articular cartilage loss, a feature of both inflammatory and non-inflammatory arthritis.

A lateral view is obligatory for assessing the shape, position and architecture of the femoral head; for example, when a slipped epiphysis or avascular necrosis is suspected. Special tangential views are helpful when assessing congruency between the acetabular socket and the femoral head.

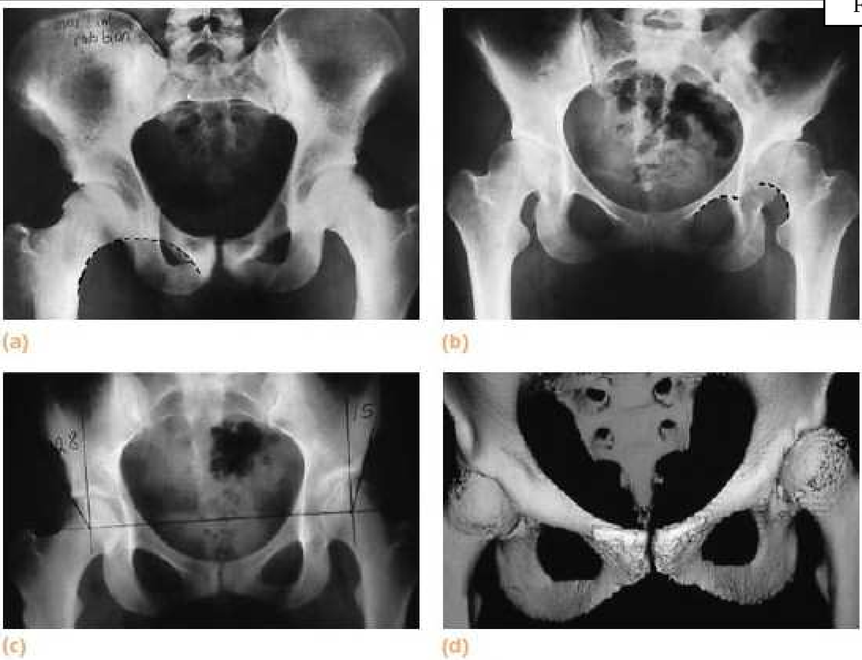


Fig.9.20

Imaging (a) Antero-posterior x-ray of normal hips, showing Shenton's line. (b) X-ray of a patient with secondary osteoarthritis of the left hip due to congenital subluxation. The joint 'space' is narrowed and Shenton's line is broken. (c,d) X-ray and three-dimensional CT showing how shallow the acetabula are, and how much of the femoral head is uncovered, especially in this dysplastic left hip. (Courtesy of Professor Kjeld Søballe, Århus Universitetshopital.)

THE DIAGNOSTIC CALENDAR:

Hip disorders are characteristically seen in certain well-defined age groups. While there are exceptions to this rule, it is sufficiently true to allow the age at onset to serve as a guide to the probable diagnosis.

Table 19.1 The diagnostic calendar: age of onset can be a guide to probable diagnosis

Age of onset (years)	Probable diagnosis
0 (birth)	Developmental dysplasia
0–5	Infections
5–10	Perthes' disease
10–20	Slipped epiphysis
Adults	Arthritis

PAIN AROUND THE HIP

Anteriorly (groin)
Synovitis and arthritis
Perthes' disease
Labral tear or detachment
Loose bodies in the joint
Stress fracture
Osteitis pubis
Other bone lesions
Inguinal hernia
Inguinal lymphadenopathy
Iliopsoas tendinitis or bursitis
Iliopsoas abscess
Adductor longus strain or tendinitis

Laterally
Referred from spine
Slipped epiphysis
Trochanteric bursitis
Stress fracture
Trochanteric tuberculosis

Posteriorly
Referred from spine
Gluteus medius tendinitis

COXA VARA:

The normal femoral neck–shaft angle is 160 degrees at birth, decreasing to 125 degrees in adult life. An angle of less than 120 degrees is called coxa vara. The deformity may be either congenital or acquired.

CONGENITAL COXA VARA:

This is a rare developmental disorder of infancy and early childhood. It is due to a defect of endochondral ossification in the medial part of the femoral neck. When the child starts to crawl or stand, the femoral neck bends or develops a stress fracture, and with continued weightbearing it collapses increasingly into varus and retroversion. Sometimes there is also shortening or bowing of the femoral shaft. As the child grows, the proximal femur keeps elongating but the neck–shaft angle goes into increasing varus. The condition is bilateral in about one-third of cases.

Clinical features: The condition is usually diagnosed when the child starts to walk. The leg is short and the thigh may be bowed. X-rays show that the femoral neck is in varus and abnormally short. Often there is a separate fragment of bone in a triangular notch on the inferomedial surface of the femoral neck. Because of the distorted anatomy, it is difficult to measure the neck– shaft angle. A helpful alternative is to measure *Hilgenreiner's epiphyseal angle* – the angle subtended by a horizontal line joining the centre (triradiate cartilage) of each hip and another parallel to the physeal line; the normal angle is about 30 degrees (Fig. 19.21a) while the angle on the abnormal side is much larger (Fig. 19.21c). At maturity the deformity may be quite bizarre. With bilateral coxa vara the patient may not be seen until he or she presents as a young adult with OA.

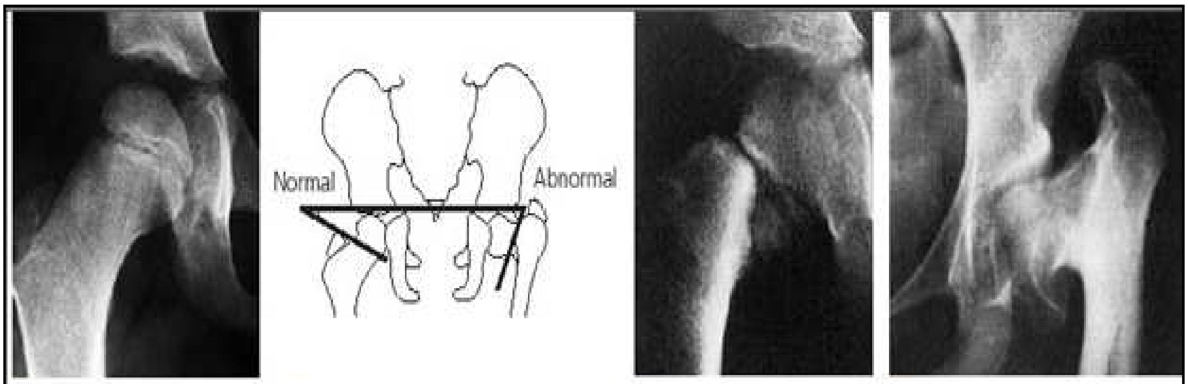


Fig.9.21 (b) (c) (d)

Infantile coxa vara In the normal hip (a) Hilgenreiner's epiphyseal angle is well within the normal range of 30–40°. The measurements are shown in (b). On the opposite side (c) the physis is too vertical: 45–60° calls for careful follow-up and review, and more than 60° is an indication for Pauwels' valgus osteotomy. In a neglected case (d) the trochanteric physis allows further growth but the femoral neck may remain fixed in marked varus.

NOTES ON APPLIED ANATOMY:

The ball-and-socket arrangement of the hip combines stability for weightbearing with freedom of movement for locomotion. A deeper acetabulum would confer greater stability but would limit the range of movement. Even with the fibrocartilaginous labrum the socket is not deep enough to accommodate the whole of the femoral head, whose articular surface extends considerably beyond a hemisphere.

The opening of the acetabulum faces downwards and forwards (about 30 degrees in each direction); the neck of the femur points upwards and forwards. Consequently, in the neutral position, the anterior portion of the head is not 'contained'. The amount of

forward inclination of the neck relative to the shaft (the angle of anteversion) varies from 10 to 30 degrees in the adult. The upward inclination of the neck is such that the neck–shaft angle is 125 degrees.

A neck–shaft angle of less than 125 degrees is referred to as ‘coxa vara’ because, were the neck normally aligned relative to the pelvis, the limb would be deviated towards the midline of the body – in varus; a neck–shaft angle greater than 125 degrees (i.e. with the neck unduly vertical) is coxa valga. The angle is mechanically important because the further away the abductor muscles are from the hip, the greater is their leverage and their efficiency.

During standing and walking, the femoral neck acts as a cantilever; the line of body weight passes medial to the hip joint and is balanced laterally by the abductors (especially gluteus medius). The combination of body weight, leverage effect and muscle action means that the resultant force transmitted through the femoral head can be very great – about five times the body weight when walking slowly and much more when running or jumping. It is easy to see why the hip is so liable to suffer from cartilage failure – the essential feature of osteoarthritis.

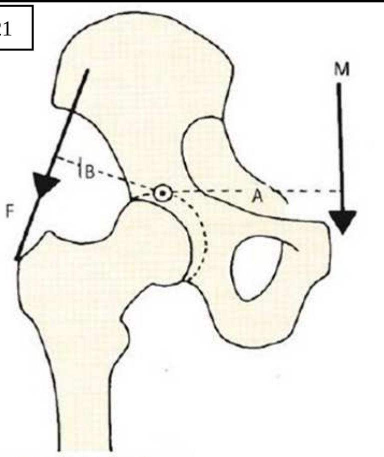
The ligaments of the hip, though very strong in front, are weak posteriorly; consequently, posterior dislocation is much more common than anterior. When the hip is adducted and medially rotated it is particularly vulnerable, and when this position results from unbalanced paralysis the hip can slip unobtrusively out of position.

During the swing phase of walking not only does the hip flex, it also rotates; this is because the pelvis swivels forwards. As weight comes onto the leg, the abductor muscles contract, causing the pelvis to tilt downwards on the weightbearing side; it is failure of this abductor mechanism which causes the Trendelenburg lurch.

The femoral head receives its arterial blood supply from three sources: (1) intraosseous vessels running up the neck, which are inevitably damaged with a displaced cervical fracture; (2) vessels in the retinacula reflected from capsule to neck, which may be damaged in a fracture or compressed by an effusion; and (3) vessels in the ligamentum teres, which are undeveloped in the early years of life and even later convey only a meagre blood supply. The relative importance of these vessels varies with age, but at all ages avascular necrosis is a potential hazard.

The nerve supply of the hip, unlike the blood supply, is plentiful. Sensory fibres, conveying proprioception as well as pain, abound in the capsule and ligaments. The venous sinusoids of the bones also are supplied with sensory fibres; a rise in the intraosseous venous pressure accounts for some of the pain in osteoarthritis, and a reduction of this pressure for some of the relief which may follow osteotomy. The tensor fasciae femoris, though a relatively small muscle, has, through its action in tightening the iliotibial tract, a surprisingly large range of functions. This tract is anterior to the axis of knee flexion when the knee is straight, so its tension helps to hold the knee slightly hyperextended while standing. It is also important in getting up from the sitting position, as well as during the phases of walking and running when weight is being taken on the slightly flexed knee.

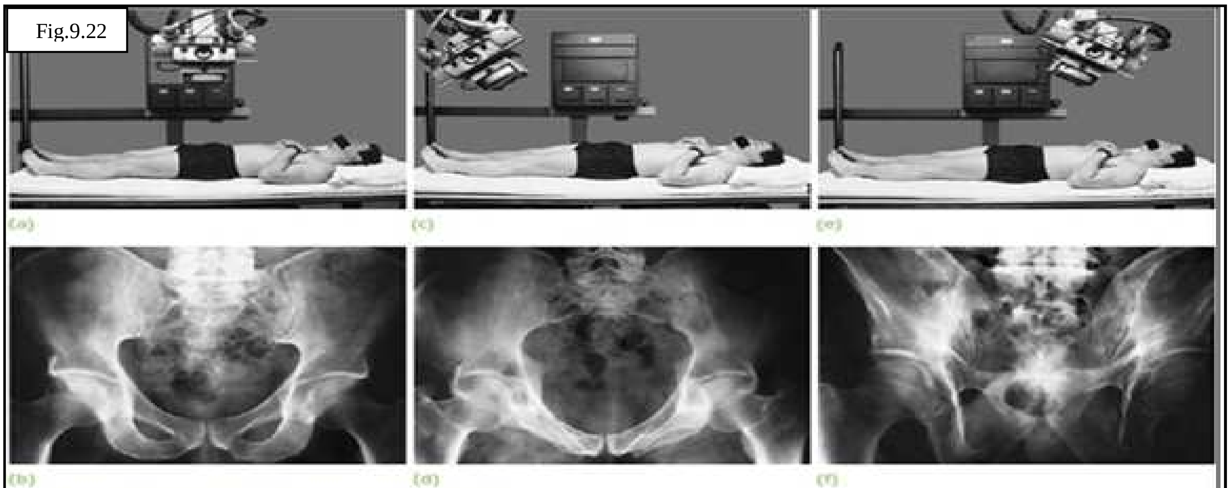
Fig.9.21



Forces around the hip When standing on one leg the pelvis is balanced on the femoral head. The vertical force due to the body weight (M) is counterbalanced by contraction of the lateral muscles (F). The force borne by the femoral head is produced by the combined moments M x A and F x B.

Pelvis X-Ray:

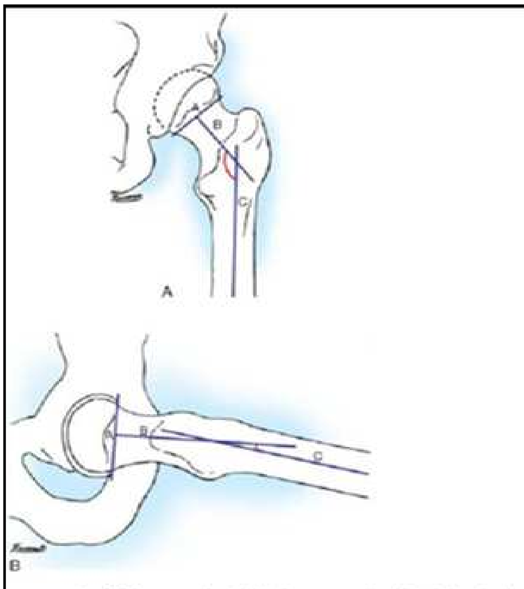
Fig.9.22



Pelvic fractures – x-ray diagnosis (1) (a,b) The anteroposterior view is usually taken during the initial assessment of the multiply-injured patient as part of a 'trauma series'. It is useful in quickly diagnosing gross disruptions or fractures. The x-ray should be read systematically: Is the picture well centred? Look for asymmetry in the pubic symphysis, the pubic rami, the iliac blades, the sacroiliac joints and the sacral foramina. If the patient's condition permits, at least two additional views should be obtained: (c,d) an *inlet* view with the tube titled 30° downwards and (e,f) an *outlet* view with the tube titled 40° upwards.

Pelvic fractures – x-ray diagnosis (2) Oblique views are helpful for defining the ilium and acetabulum on each side. (a,b) the *right oblique* view; and (c,d) the *left oblique* view. These can be omitted if facilities for CT are available.

Fig.9.23



A and B, Measurement of head-shaft angle on anteroposterior and lateral radiographs. Line A connects peripheral portions of physis. Line B is perpendicular to line A, and line C is in long axis of femoral shaft. Intersection of lines B and C forms head-shaft angle in both views.

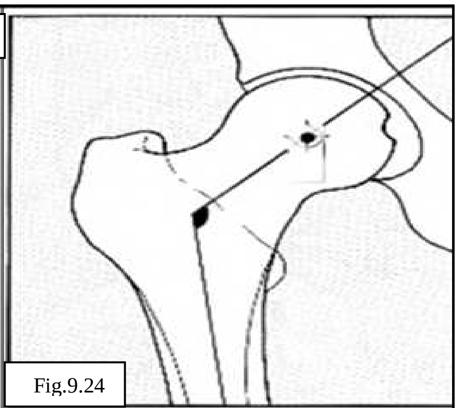


Fig.9.24

The neck–shaft angle may be measured from lines drawn through the shaft and along the centre of the neck into the centre of the head.
Normal neck–shaft angle in males = 128°.
Normal neck–shaft angle in females = 127°.
The centre of the head may be easily found with the aid of an orthopaedic rule or similar transparent drawing template inscribed with concentric circles of different radii.

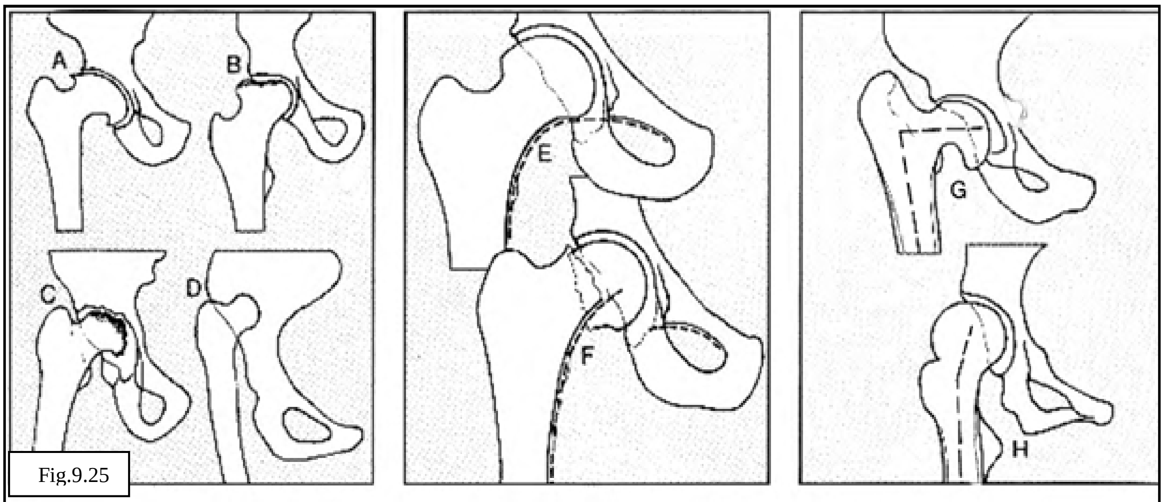
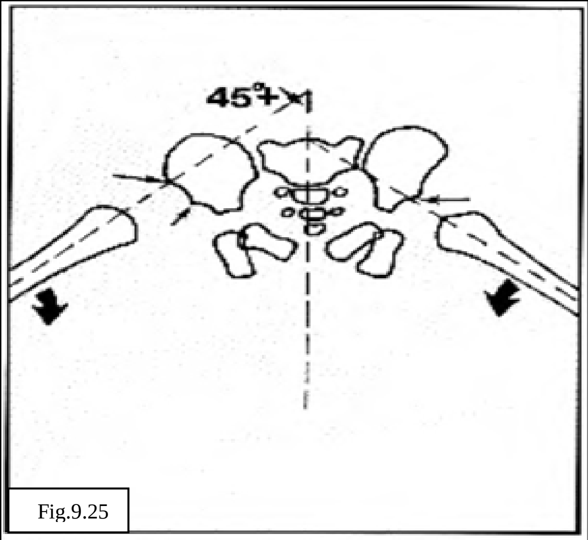


Fig.9.25

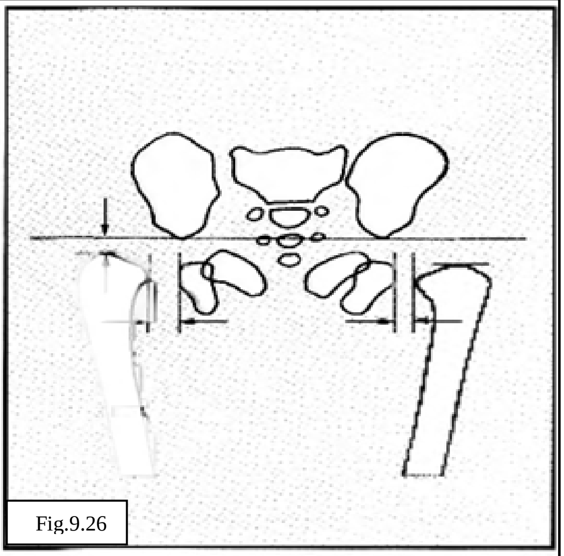
Radiographs ctd: Now note the *shape* of the femoral head, which may, for example, be (A) buffer-shaped after Perthes' disease, (B) flattened after avascular necrosis (total or segmental), (C) irregular or destroyed after infection, (D) atrophic in persistent developmental dislocation of the hip. Note *Shenton's line*, which normally forms a smooth curve flowing from the superior pubic ramus to the femoral neck (E). Compare the sides if possible. Distortion occurs in many conditions involving the femoral neck and head, particularly fractures (F) and subluxations. Note the *neck–shaft angle*. This is *decreased* in congenital coxa vara (G), and coxa vara secondary to rickets, Paget's disease, osteomalacia, fracture etc. It is *increased* in coxa valga secondary to polio (H) and other neurological disturbances.

Fig.9.25



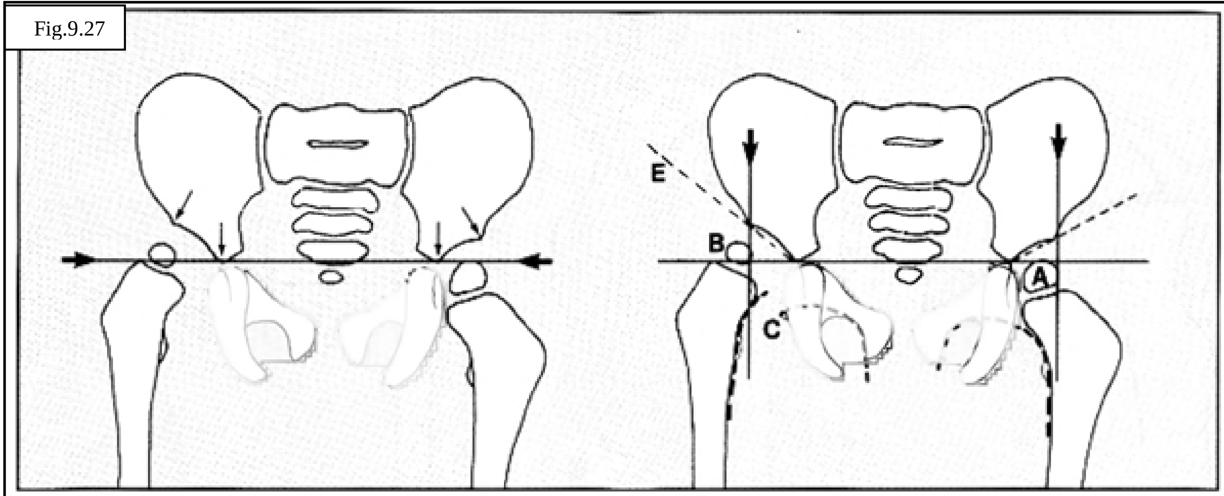
Radiographic examination of the neonate: *(a) van Rosen method:* An AP view should be taken with the hips in at least 45° abduction and full internal rotation. A line projected along the line of the femur in the normal hip should strike the acetabulum and, in a case of dislocation, the region of the anterior superior spine. Note: To avoid radiation, this somewhat unreliable investigation should be done only where there is still uncertainty after clinical and ultrasound testing.

Fig.9.26



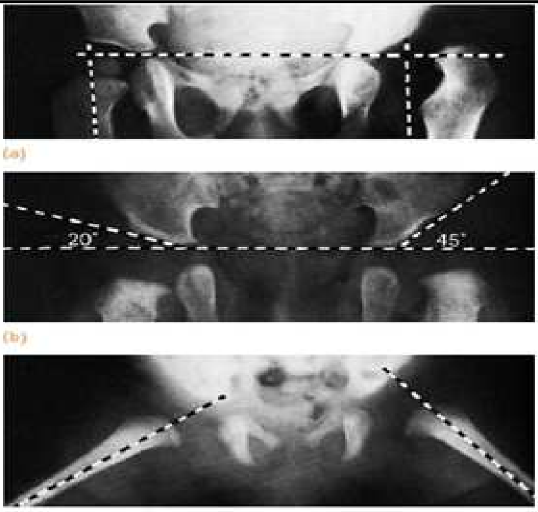
Radiographic examination: *(b) Edinburgh method:* An AP film is taken with the child's legs held parallel, with slight traction and no external rotation. Centre the beam at a standard distance of 100 cm. Measure the gap between the most medial part of the femur and the lateral edge of the ischium. This is normally 4 mm; over 5 mm is suspicious; 6 mm is regarded as diagnostic of DDH. Proximal migration can also be measured in the same film.

Fig.9.27



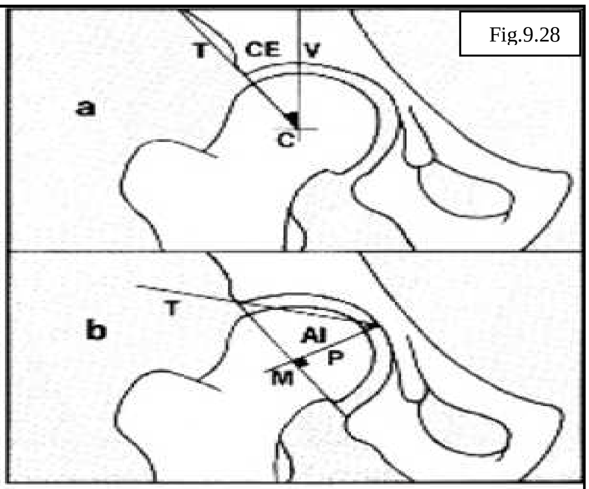
Radiographs in the child (1): Interpretation of hip radiographs in the older child is dependent on the presence of ossification in the epiphysis of the femoral head. This normally appears between 2 and 8 months, but is often delayed in DDH. The position of the capital epiphysis in relation to the other pelvic elements must be determined. First draw a horizontal line (Hilgenreimer line) across the pelvis. On each side this should touch the downward-pointing apex of the acetabular element of the ilium. Vertical lines (Perkins' lines) should then be drawn from the lateral limits of the acetabula. These lines divide the region of each hip into four areas. The epiphysis of the femoral head should normally lie within the lower and inner quadrant (A), but in DDH the head moves upwards and outwards (as at B). Shenton's line (C) may be disturbed. Dysplasia of the acetabulum alters its slope (E), which decreases with growth (it usually does not exceed 30° at 6 months). There are a number of other measurements of a specialized nature that may be made (and compared with tables detailing average values relating to age and sex) when a more detailed assessment of hip dysplasia is required.

Fig.9.28



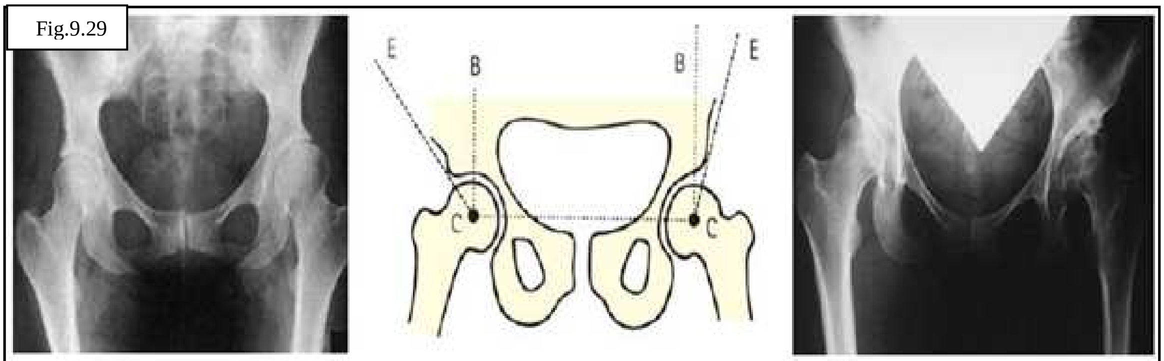
(a) (b) (c)

DDH – X-rays (a) The left hip is dislocated, the femoral head is underdeveloped and the acetabular roof slopes upwards much more steeply than on the right side. In this case the features are very obvious but lesser changes can be gauged by geometrical tests. The epiphysis should lie medial to a vertical line which defines the outer edge of the acetabulum (Perkins' line) and below a horizontal line which passes through the triradiate cartilages (Hilgenreiner's line). (b) The acetabular roof angle should not exceed 30°. (c) Von Rosen's lines: with the hips abducted 45° the femoral shafts should point into the acetabula. In each case the left side is shown to be abnormal.



Radiographs (2): To assess joint development after treatment for DDH the following may be noted (a) the centre–edge angle (CE, of Wiberg); and (b) the acetabular index (AI angle). (V is a vertical, C the centre of the femoral head, T an acetabular edge tangent, M is the midpoint of a line joining the acetabular margins, P a vertical drawn from it.) Additional information regarding the head, acetabulum and limbus may be obtained by MRI scans or contrast arthrography.

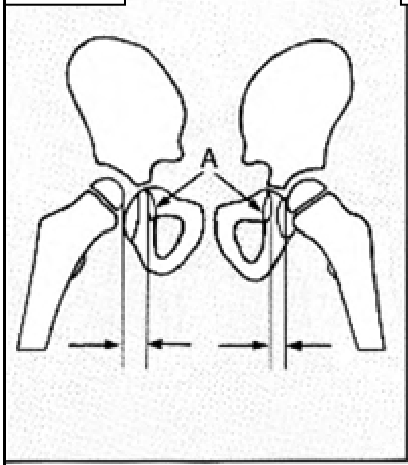
Fig.9.29



(a) (b) (c)

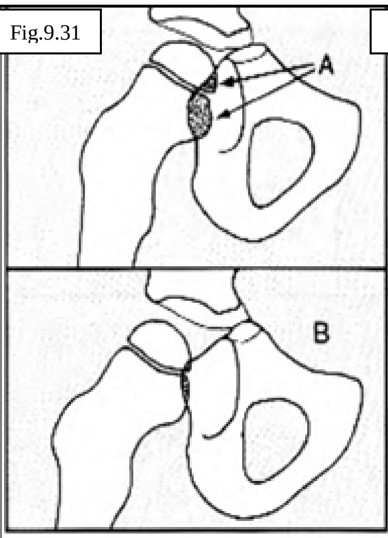
Acetabular dysplasia (a) X-ray showing a dysplastic left acetabulum. The socket is shallow and the roof sloping, leaving much of the femoral head uncovered. Note that the femoral neck–shaft angle is somewhat valgus on both sides. (b) Measuring Wiberg's centre–edge (CE) angle; the line C–C joins the centre of each femoral head; C–B is perpendicular to this and C–E cuts the superior edge of the acetabulum. The angle BCE should not be less than 30°; in this case the left hip is abnormal. (c) X-ray of another patient showing acetabular dysplasia on the right side and secondary osteoarthritis in an untreated dysplastic left hip.

Fig.9.30



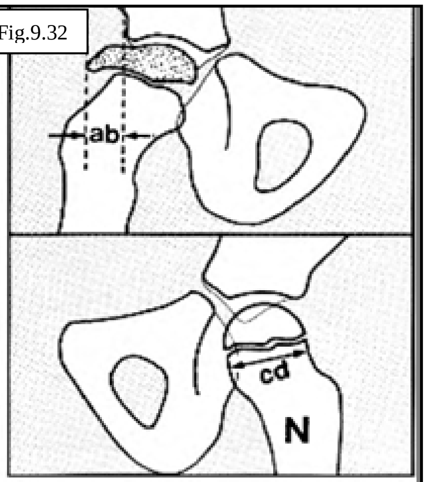
Perthes' disease · The earliest radiographic sign is an increase in joint space. (Note, however, that this is also seen in synovitis of the hip and in infective arthritis). Minor degrees of joint space widening may be detected by measuring the distance between (A) 'the tear drop' and the capital epiphysis on both sides.

Fig.9.31



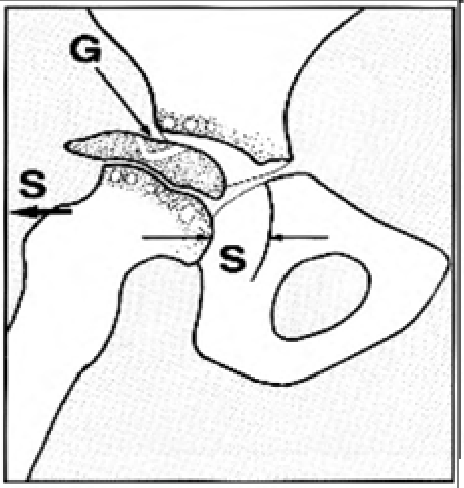
Perthes' disease . . If the 'tear drop' (formed by the anterior acetabular floor) is not clear, note (A) the overlap shadows of the head and neck on the acetabulum, comparing one hip with the other. Alteration (B) occurs in Perthes' disease, synovitis and infection.

Fig.9.32



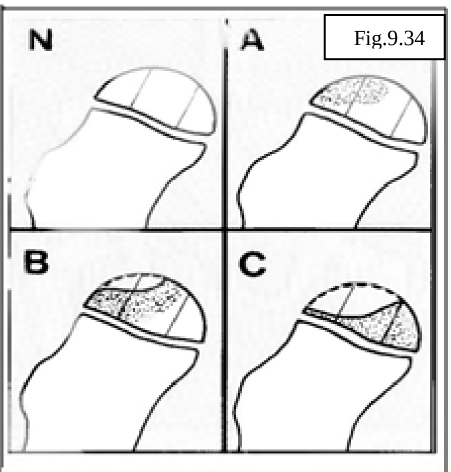
. **Perthes' disease** . : Lateral extrusion may be expressed as a percentage of the diameter of the metaphysis on the normal side (N): if ab/cd × 100 > 20%, then the prognosis is poor. An accurate assessment of the amount of avascular bone may be made by radionuclide bone scanning. Prognosis is mainly dependent on the mass and degree of epiphyseal involvement (assessed, for example, by Catterall grading).

Fig.9.33



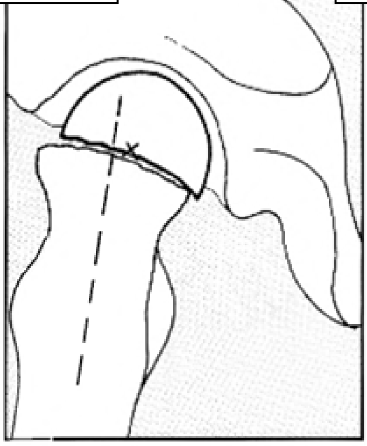
Perthes' disease ,_,: Other adverse factors placing the case in the 'head-at-risk' category include (a) presentation above the age of 4, (b) calcification seen lateral to the epiphysis or other evidence of major extrusion, (c) lateral subluxation (S), (d) a positive Gage sign (a sequestrum surrounded by a 'V' of viable epiphysis (G).

Fig.9.34



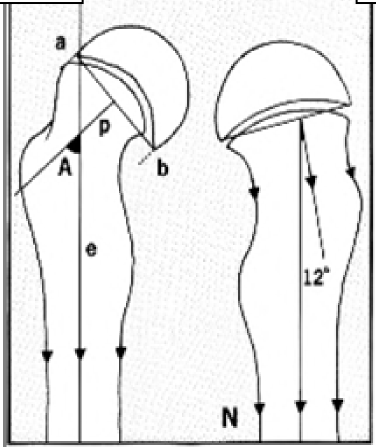
Perthes' disease _ |: *Herring lateral pillar classification:* Divide the head into three columns during the fragmentation stage: then, if the lateral part is of normal height (Herring A), the prognosis is excellent. If the lateral part is depressed up to 50% (even with the central column involved) (Herring B), the results are generally good under age 9. In Herring C the lateral pillar is less than 50% and all develop permanent deformity.

Fig.9.35



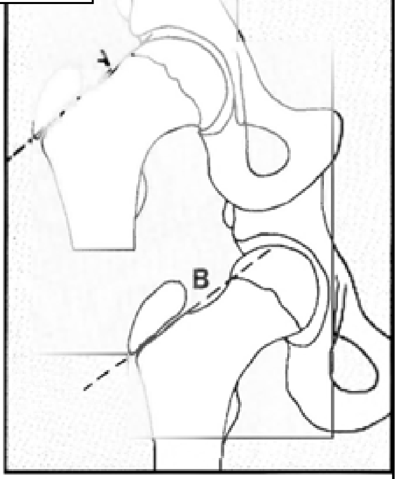
. Slipped femoral epiphysis (1): The earliest changes are seen in the lateral projection. A line drawn up through the centre of the neck fails to meet the midpoint of the base of the epiphysis. The distance between the centre of the base of the epiphysis (x) compared with the width of the base of the epiphysis may be used to calculate the degree of slip. Less than 1/3 may be classified as grade 2; grade 3 = 1/3 to 1/2; grade 4 = more than 1/2. (Grade 1 is used for pre-slip cases.)

Fig.9.36



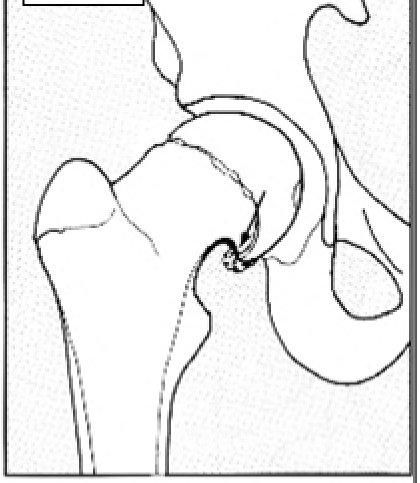
Slipped femoral epiphysis (2): *Southwick's method of quantifying the severity of any slip:* In the frog lateral draw a perpendicular (p) from a line (ab) drawn across the base of the epiphysis. Note the angle (A) between this and a line (e) drawn through the centre of the femoral shaft, and compare the sides. (If the condition is unilateral, subtract 12° to allow for the normal–shaft angle in this projection.) 30° is regarded as mild; 30–60° is moderate, and more than 60° severe.

Fig.9.37



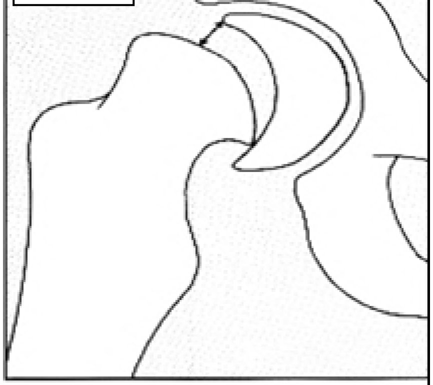
Slipped femoral epiphysis (3): Although the earliest radiographic changes are seen in the lateral, greater degrees of slip become detectable in the AP projections. The first sign is that a tangential line drawn on the upper femoral neck fails to strike the epiphysis (A), whereas in a normal well-centred view such a tangent (B) includes part of the epiphysis.

Fig.9.38



. Slipped femoral epiphysis (4): In the later stages, some weeks after the initial slip (now the so-called 'chronic slip' stage) there is distortion of the inferior part of the femoral neck, with new bone formation ('buttressing').

Fig.9.39



. Slipped femoral epiphysis (5): *Physeal separation:* the frog lateral radiograph is again used. The distance between the anterior lip of epiphysis and the closest point of the metaphysis is measured. In the majority of cases of slipped femoral epiphysis there is in fact no physeal separation. If separation is present, it is seldom detected unless it exceeds 4 mm. Detected separations normally lie in the 4–12 mm range. Separation is a significant finding, as it tends to be associated with a high incidence of avascular necrosis.

Fig.9.40

SCFE A. AP view B. Lateral view

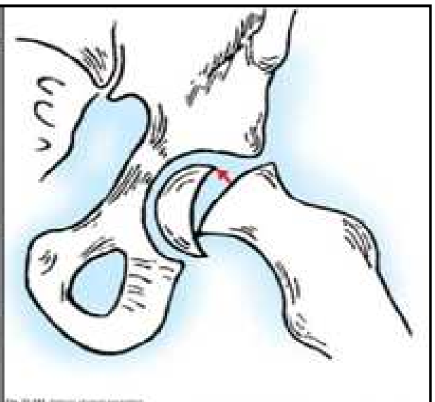
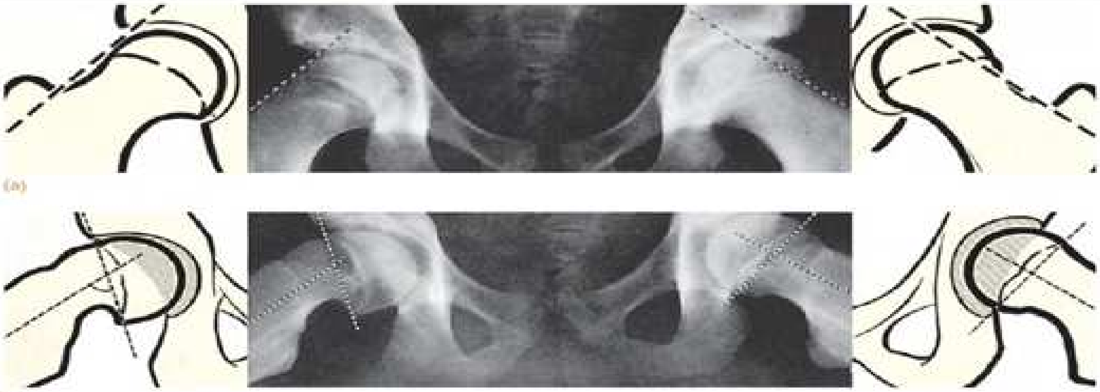
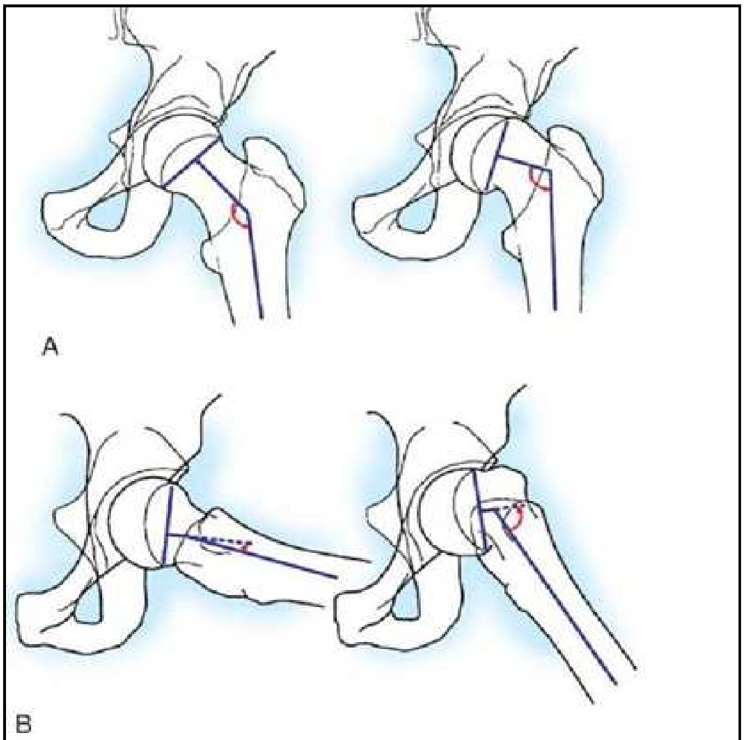


Fig.9.41



Slipped epiphysis – x-rays (a) Anteroposterior and (b) lateral views of early slipped epiphysis of the right hip. The upper diagrams show Trethowan's line passing just above the head on the affected side, but cutting through it on the normal side. The lateral view is diagnostically more reliable; even minor degrees of slip can be shown by drawing lines through the base of the epiphysis and up the middle of the femoral neck – if the angle indicated is less than 90°, the epiphysis has slipped posteriorly.

Fig.9.42 **A** and **B**, Acute SCFE with moderate displacement. **C** and **D**, After in situ pinning with cannulated cancellous hip screws.



Extracapsular base-of-neck osteotomy: measurement of head-shaft angles on radiograph. **A,** Normal anteroposterior angle compared with SCFE. **B,** Normal lateral angle compared with SCFE.

Fig.9.43

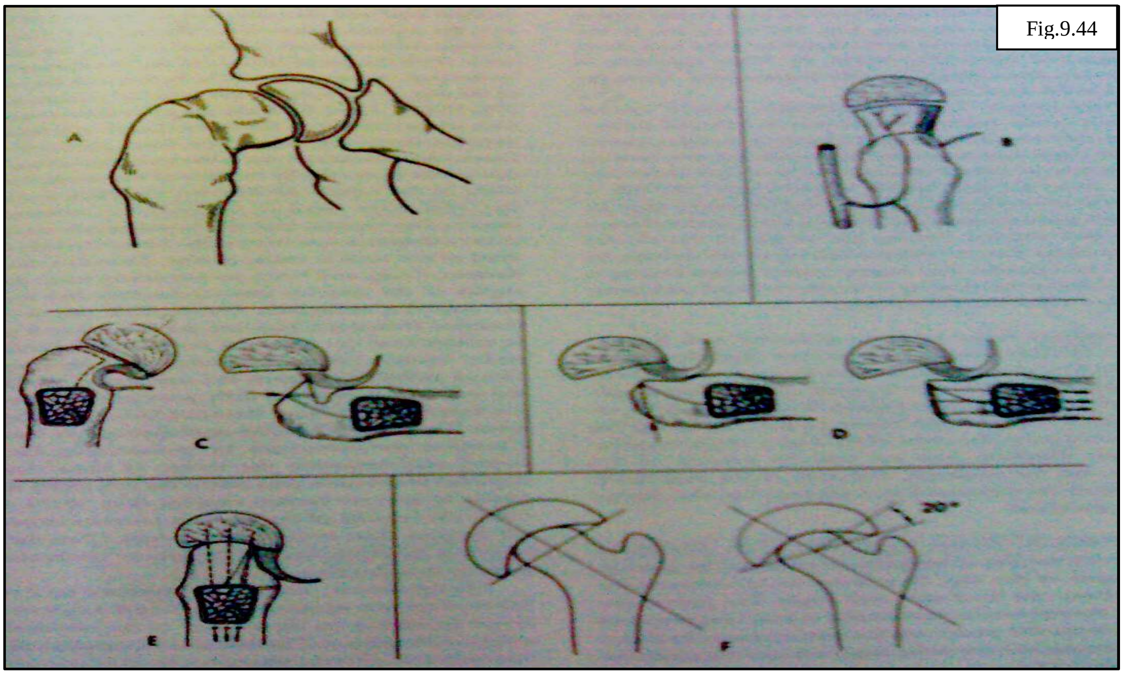
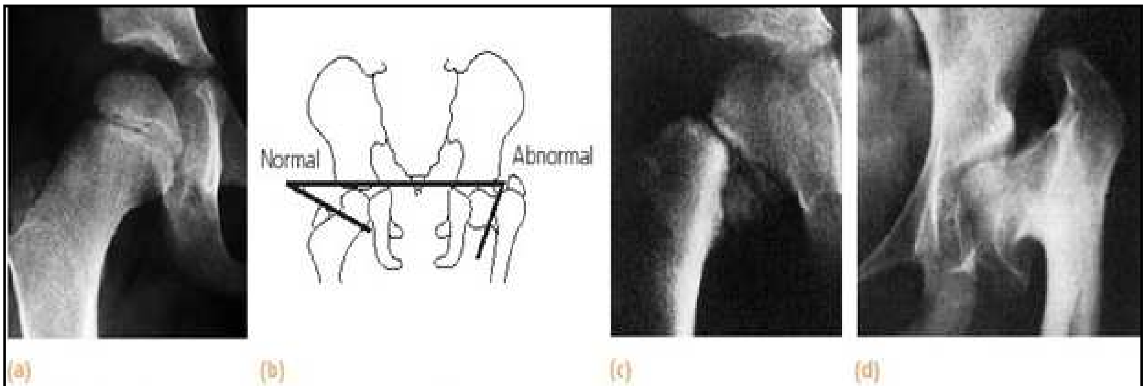


Fig.9.44

Fig.9.45



Infantile coxa vara In the normal hip (a) Hilgenreiner's epiphyseal angle is well within the normal range of 30–40°. The measurements are shown in (b). On the opposite side (c) the physis is too vertical: 45–60° calls for careful follow-up and review, and more than 60° is an indication for Pauwels' valgus osteotomy. In a neglected case (d) the trochanteric physis allows further growth but the femoral neck may remain fixed in marked varus.

The Knee

History

Pain

- Onset- Insidious.

  Acute.

  Diffuse pain – Inflammation.

  Localized pain – Injury.

From history:-

Mechanism of injury

- Direct blow to the front of the knee- patella-femoral injury.
- Blow to the side- rupture of the collateral ligament.
- Twisting – torn meniscus or cruciate ligament.

Swelling:-

a- Diffuse.

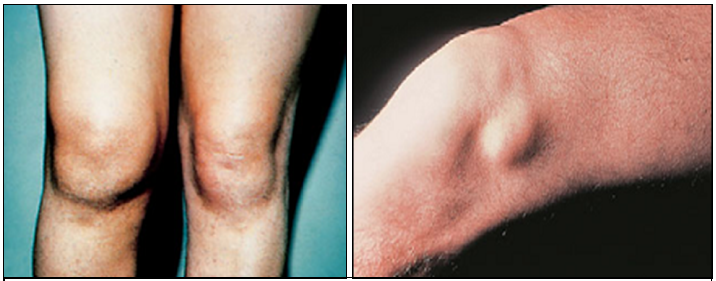
b- Localized.

In case of trauma:-

- If the swelling appear immediately---(Haemoarthrosis).
- After some hours (Effussion).

Recurrent swelling with more or less normal period in between

- Old meniscus tear.
- Small osteoarticular fracture.
- Loose bodies in the joint.



Knee Swelling
A- Diffuse.
B- Localized.

Fig 10.1

Chronic swelling:-

- Synovitis.
- Arthritis.

Stiffness

Common after:-

- Trauma.
- Infection.
- Operation.

Stiffness that appears irregularly after a period of rest – so-called- "post-inactivity stiffness", which suggest some type of chronic arthritis (e.g. Rheumatoid).

Locking

The knee, Quite suddenly, cannot be straightened fully, although flexion is still possible.

- Meniscus tear.
- Loss body.

Caught between articular surfaces.

By wiggling the knee around, the patient may able to "un-lock" it.
Sudden unlocking is the most reliable evidence that something mobile had previously obstructed full extension.
Do not be missed by "pseudo-locking", when movement is suddenly stopped by pain or the fear of impending pain.

Giving way

A feeling of instability, or a lack of trust in the knee.
Mechanical Disorder

- Ligamentous injury.
- Meniscus tear.
- Capsular injury.

Limp

- Pain.
- Instability.

Loss of function

- Progressively diminishing walking distance.
- Inability to run.
- Difficulty going up and down steps.
- Painful squatting.
- Painful kneeling.

Inspection

- **Gait.**
  - antalgic gait.
- **Attitude.**
  - holding the knee by hands.

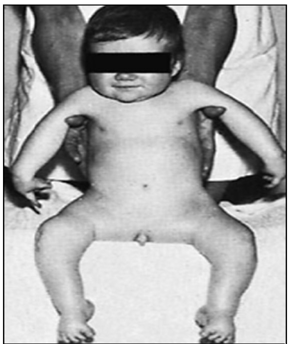
Fig 10.2

- **Posture**
  - Genu Varum.
  - Genu Recurvatum.
  - Genu Valgum.

A- Genu Varum.
B- Genu Valgum.
C- Genu Recurvatum.

Fig 10.3

Skin:- colour, dilated veins, café au lait spots.
Swellings. Neurofibroma.
Absence of creases. Arthrogryposis Multiplex Congenita.



Arthrogryposis Multiplex Congenita.

Fig 10.4

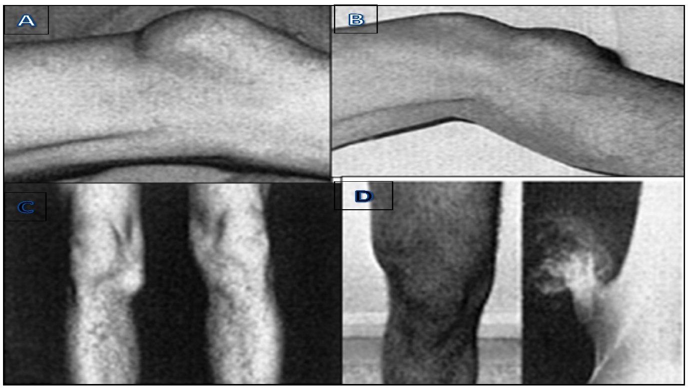
Swelling

1- Note the presence of swelling confined to the limits of the synovial cavity and suprapatellar pouch-suggesting effusion, haemoarthrosis, pyarthrosis, or a space-occupying lesion in the joint.
2- Note if the swelling extends beyond the limits of the joint cavity, suggesting infection (of the joint, femur or tibia), tumour or major injury.

Lumps

Note presence of localized swellings

A- Pre-patellar bursitis.
B- Infra-patellar bursitis.
C- Meniscus cyst (in the joint line).
D- Diaphyseal aclasis (exostosis, often multiple and sometimes familial).



A- Pre-patellar bursitis.
B- Infra-patellar bursitis.
C- Meniscus cyst (in the joint line).
D- Diaphyseal aclasis.

Fig 10.5

Discoloration

- Note bruising, suggesting trauma to the superficial tissues, or ligament injuries (bruising is not usually seen in meniscus injuries).

- Note any redness suggesting inflammation.

Fig 10.6

Fig 10.7

Synovitis of Rheumatoid Arthritis

Skin marks

- Note:-
  a- Scars of previous injury or surgery- the relevant history must be obtained.
  b- Sinus scars indicate old infection.
  c- Note that arthritis and psoriasis are often associated.

Fig 10 7

Temperature

1- Note any increased local heat and it's extent, suggesting in particular Rheumatoid arthritis or infection.
2- A warm knee and cool foot suggest a popliteal artery block.

The Quadriceps

1- Inspect the relaxed quadriceps muscle, slight wasting and loss of bulk are normally apparent on careful inspection.
2- Examine the contracted quadriceps:-
   - Place a hand behind the knee and ask the patient to press the leg against the hand.
   - Feel the muscle tone with the free hand.
3- Repeat the last test, this time asking the patient to dorsiflex the inverted foot.
   - This demonstrates the important vastus medialis portion of the quadriceps, which may be involved in recurrent dislocation of the patella.
4- Compare the circumference of the leg at the marked levels(18 cm above the joint line).

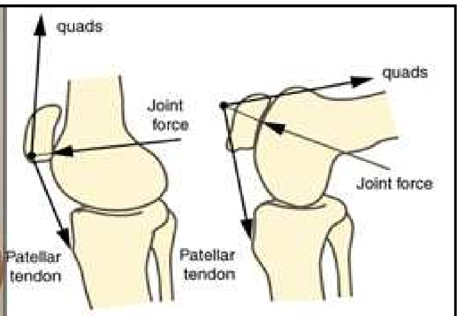

Fig.10.8

-Wasting of the quadriceps occurs most frequently as the result of disuse, generally from a painful or unstable lesion of the knee, or from infection or Rheumatoid arthritis.

Extensor Apparatus

1- Loss of active extension of the knee (excluding paralytic conditions) follows:-

Fig 10.9



Force vector complex of the patellofemoral joint at extension and flexion. This shows that the tension ratio of the quadriceps and patellar tendon varies with flexion due to the change in contact position of the patellar with the femur.

1- Rupture of quadriceps tendon.

2- Many patellar fractures.

3- Rupture of patellar ligament.

4- Avulsion of the tibial tubercle.

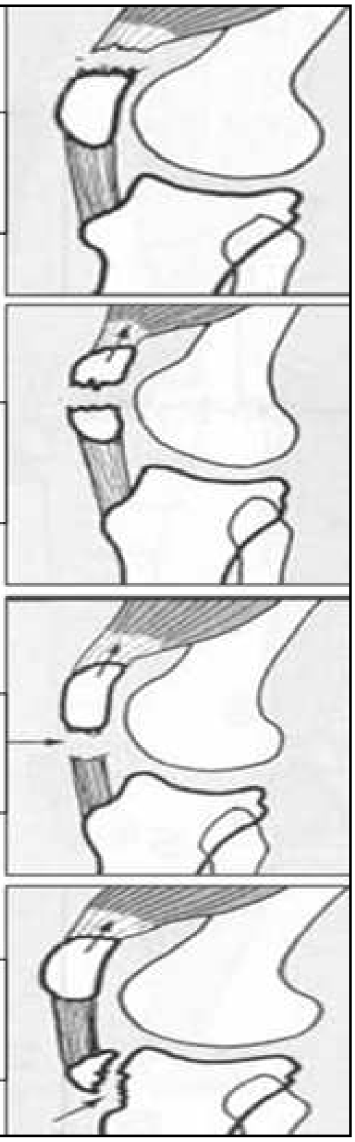


Fig.10.10

2- Ask the patient to straighten the leg while supporting the ankle with one hand.
   - Feel for quadriceps contraction, and look for active extention of the limb.
3- Note the position of the patella (both).
   - If the upper border heigh, suspected lesion 2,3, or 4.(fracture patella, rupture patellar ligament, or avulsion of tibial tubercity).
4- If the patella is normally placed, lay a finger along its upper border
   - Loss of the normal soft tissue resistance is suggestive of a rupture of quadriceps tendon.
5- Look for gaps and tenderness at the other levels to help differentiate between lesion 2,3 and 4.
   - Radiographs of the knee are important.

Effusion

1- Small effusions are detected most easily by inspection.
   - The first signs are bulging at the sides of the patellar ligament and obliteration of the hollows at the medial and lateral edges of the patella.

Fig 10.11

2- With greater effusion into the knee, the supra-patellar pouch becomes distended.
   - Effusion indicates synovial irritation from trauma or inflammation.

Fig 10.12

3- **Patellar tap**

A – squeeze any excess fluid out of the supra-patellar pouch with the index and thumb, slid firmly distally from a point about 15 cm above the knee to the level of the upper border of patella.
B- place the tip of the thumb and three fingers of the free hand squarely on the patella, and jerk it quickly downwards.
   - A click indicates the presence of effusion.
   - If, however, the effusion is slight or tense, the tap test will be negative.

Fig 10.13 Patellar Tap

4- ***Fluid displacement test:***

- Small effusion may be detected by this maneuver.
- Evacuate the supra-patellar pouch, as before in the patellar tap test.
- Stroke the medial side of the joint to displace any excess fluid in the main joint cavity to the lateral side of the joint.
- Now stroke the lateral side of the joint while watching closely the medial.
- Any excess fluid present will be seen to move across the joint and distended the medial side.
- This test will be negative if the effusion is gross and tense.

Fig 10.14

Fig 10.15

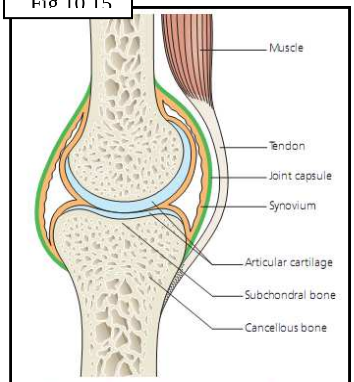


Diagram showing the components of a synovial joint

Synovial Membrane

- Pick up the patella and relaxed quadriceps tendon to assess the thickness of the synovial membrane in the supra-patellar pouch, if the membrane is thick you cannot pick up the patella.
- The synovial membrane is thickened in inflammatory condition, e.g. Rheumatoid arthritis, and in Villo-nodular synovitis.

Fig 10.16

Tenderness

1- It is first essential to identify the joint line quite clearly.
   - First flex the knee, and look for the hollows at the sides of the patellar ligament:- these lie over the joint line.
   - Confirm by pressing backwards with the finger or thumb, identifying the soft hollow between the prominence of the femur above, and the tibia below.

2- Joint line structures

- Being by palpating carefully from befor back along the joint lines on each side.
- Localized tenderness here is commonest in meniscus collateral ligament and fat pad injuries.

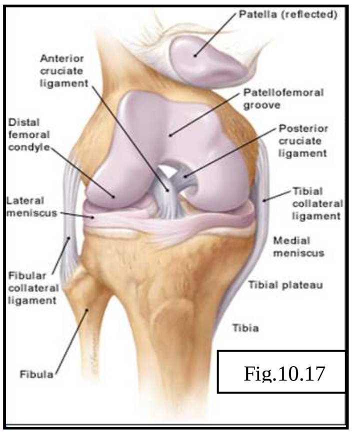


Fig.10.17

3- Collateral ligaments
   - Now systematically examine the upper and lower attachments of the collateral ligaments.
   - Associated bruising and oedema is a feature of acute injuries.

4- Tibial tubercle
   - In children and adolescent, tenderness is found over the tibial tubercle (which may be prominent) in Osgood-Schlatter's disease and after acute avulsion injuries of the patellar ligament and it's tibial attachment.

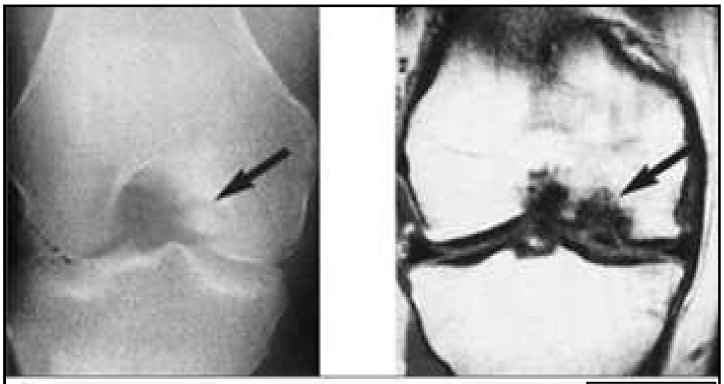
Fig.10.18

Osgood-Schlatter's disease

Avulsion injuries of the patellar ligament and it's tibial attachment.

5- Femoral condyles
   - In suspected osteochondritis dissecans, flex the knee fully and look for tenderness over the femoral condyles.

- Osteochondritis dissecans most frequently involves the medial femoral condyle, and particular attention should therefore be paid to the side.



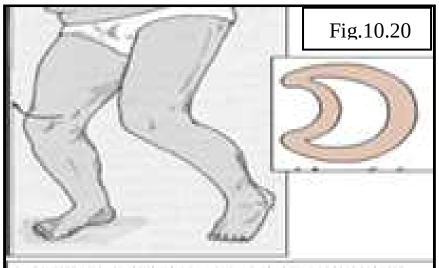
Osteochondritis dissecans Fig.10.19

Movements

1- Extension:-

1- Fist make sure that the knee can be fully extended.
  - If in doubt, lift both legs and slight along the good and affected leg.
  - Full extension is recorded as 0^0 (zero).
  - Loss of full extension may be recorded as (the knee lack of x^0 of extension).
2- Try to obtain full extension if this is not present
  - A springy block to full extension is very suggestive of a bucket handle meniscus tear.
  - A rigid block to full extension is a common in arthritis conditions (fixed flexion deformity).

Fig.10.20



Bucket handle meniscus tear.

3- Hyperextension (genu recurvatum)
  - This is present if the knee extends beyond the point when the tibia and femur in line.
  - Attempt to demonstrate this by lifting the leg while at the same times pressing back on the patella.
  - If severe, look for other signs of joint laxity, particularly in the elbow, wrist and fingers, keeping in mind the rare Ehlers-Danlos syndrome.
4- Hyperextension, if present, is recorded as X^0 hyperextension.
  - It is seen most often in girls. Often being associated with a high patella, chondromalacia patlla, recurrent patellar dislocation, and

sometimes tears of the anterior cruciate, medial ligament, or medial meniscus.

2- *Flexion*

1- Measure in degree from the zero position of normal full extension.
   - Flexion of 135^0 and over is regarded as normal, but compare the sides.
   - There are many causes of loss of flexion, the commonest of which are effusion and arthritis conditions.
2- Alternatively, measure the heel to buttock distance with the leg fully flexed.
   - This can be a very accurate way of detecting small alterations in the range (1cm=1.5^0 approximately) and is useful for checking daily or weekly progress.

Power

Examine the power of the muscles of the leg moving the ankle and foot joints.

Fig.10.21

Knee Extension againt resistance | **Knee flexion against resistance**

Sensation

Examine the sensation according to the dermatomal distribution of the lower limbs.

Reflex

- The knee jerk L4.
- The ankle jerk S1.

Special Test

Genu Valgum (knock knee) in children

1. Note whether unilateral, or as usual, bilateral.

The severity of the deformity is recorded by measuring the inter-malleolar gap.

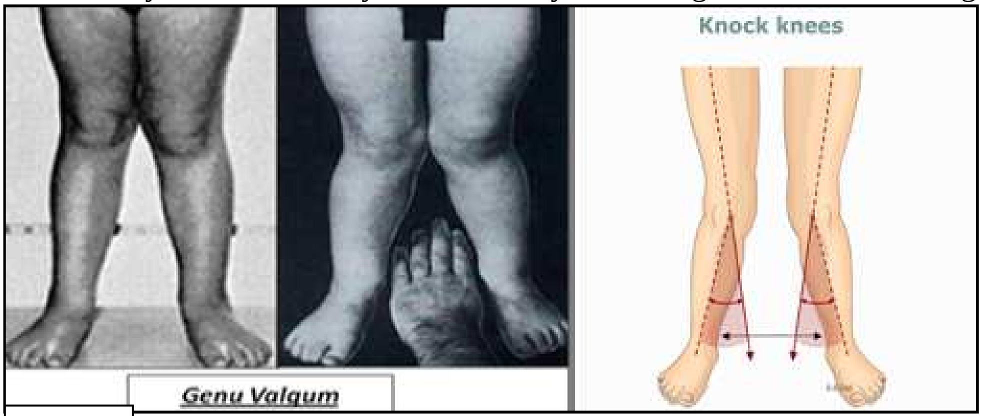


Fig.10.22

Grasp the child by the ankles, and rotate the legs until the patellar are vertical.

2.now bring the legs together to touch lightly at the knees, and measure the gap between the malleali.

Serial measurements, often every six months, are used to check progress.

Note that with growth, a static measurement is an angular improvement.

Genu valgum in adults

1.in adults the deformity is often secondary to osteoarthritis or rheumatoid arthritis, and it is also common in teenage girls.

It is best measured by X-ray, and the films should be taken with the patient taking all his weight on the affected side.

2.the degree of valgus maybe roughly assessed by measuring the angle formed by the tibial and femoral shafts.

Allow for the " normal " angle which is approximately 6^0 in the adult.

The shaded area represents genu valgum.

Genu varum (bow leg)

1.measure the distance between the knees , using the fingers as a gauge.

Ideally the patient should be weight-bearing, and it is essential that both patellae should be facing forwards to counter any effect of hip rotation.

2.an assessment of the deformity may also be carried out radiographically , as in genu valgum

The deformity is seen most in osteo arthritis , rheumatoid arthritis and Paget's disease.

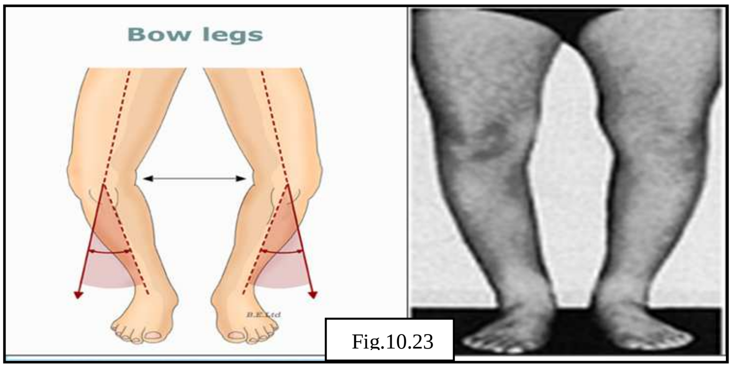


Fig.10.23

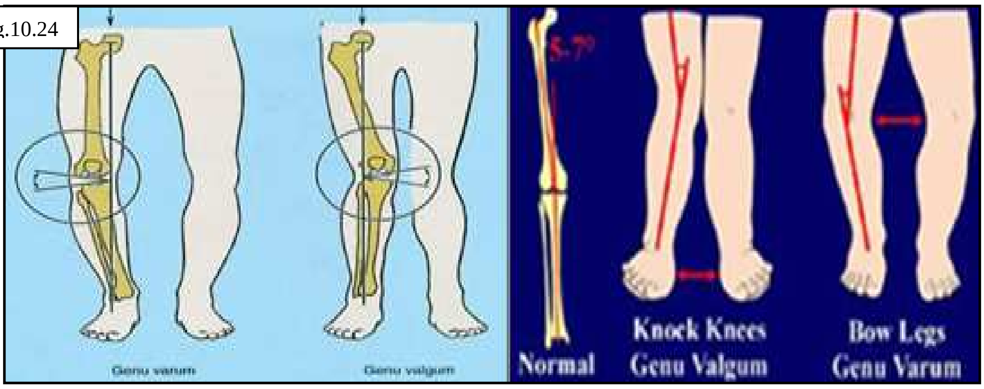
3.in children,radiography maybe helpful in

a.rickets:- note the wide and irregular epiphyseal plates

b.tibia vara:- note the sharply downturned medial metaphyseal border

-note that radiographical varus is normal till a child is eighteenth month old.

Fig.10.24



Instability in the knee

The following potential deformities maybe looked for:

a. Valgus (when the medial legament is torn, severe when the posterior cruciate is also torn)

b.Varus (when the lateral ligament is torn, severe when the posterior cruciate is also torn)

c.Anterior displacement of the tibia (anterior cruciate tear, worse if medial and/or lateral structures torn)

d.Posterior displacement of the tibia (posterior cruciate ligament tears)

e.Rotatory, with the following sub-divisions:-

1.the medial tibial condyle subluxes anteriorly (anterio-medial instability, occurs mainly with tears of the anterior cruciate and medial structures together)

2.the lateral condyle subluxes anteriorly (anterio-lateral instability mainly anterior cruciate with the lateral structures)

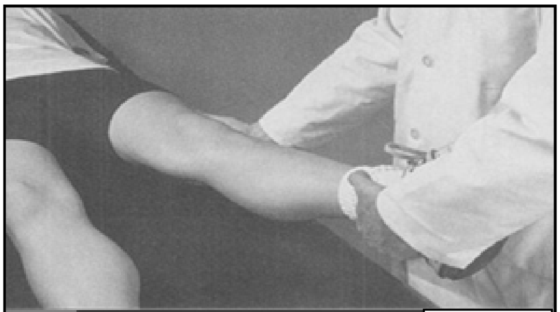
3.the lateral tibial condyle subluxes posteriorly (postero-lateral instability, mainly tears the posterior cruciate and lateral structures)

4.combinations of 1 and 2, or, 2 and 3.

Valgus stress instability

1.begin by examining the medial side of the joint, and the medial ligament in particular. Tenderness in injuries of the medial ligament is commonest at the upper(femoral) attachment and in the medial joint line.

Bruising maybe present after recent trauma, but haemarthrosis maybe absent.



Valgus Stress Test Fig.10.25

2.extend the knee fully. Use one hand as a fulcrum, and with the other attempt to abduct the leg.

Look for the joint opening up, and the leg going into valgus

Moderate valgus is suggestive of a measure medial and posterior ligament rupture.

Severe valgus indicates additional cruciate (particularly posterior cruciate) rupture.

3. if in doubt, use the heel of the hand as a fulcrum, and use the thumb or index, placed in the joint line, to detect any opening up of the joint as it is stressed

If there is some uncertainty, compare the sides.

4. stress films:

If there is still some doubt, then radiographs of both knees should be taken while applying a valgus stress to each joint. The films as both sides are then compared. Any Instability should be obvious.
If no instability has been demonstrated with the knee fully extended, repeat the tests with the knee flexed to 30 and the foot internally rotated
Some opening up of the joint is normal, and it is essential to compare sides
Demonstration of an abnormal amount of valgus suggests less extensive involvement of the medial structures.If the knee is very tender, and will not permit the pressure of a hand as a fulcrum.

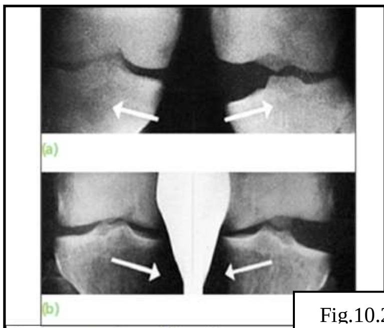


Fig.10.26

Stress x-rays Stress films show
(a) complete tear of medial ligament, left knee;
(b) complete tear of lateral ligament.
In both, the anterior cruciate also was torn.

Attempt to stress the ligament with this cross-over arm grip, with one hand placed over the proximal part of the tibia distal to the knee joint.


Fig.10.27

If a haemarthrosis is present (and this is not always the case) preliminary aspiration of the joint may make a useful examination possible.
If the knee remains too painful to permit examination, the joint should be fully tested under anaesthesia, there should be provision to carry on with a surgical repair should major instability be demonstrated (e.g. with the involvement of several major structures).

<u>Varus stress instability</u>

1.Begin by examining the lateral side of the joint.
Tenderness is most common over the head of the fibula or in the lateral joint line in acute injuries of the lateral joint complex (lateral ligament and capsule)
2.Attempt to produce a varus deformity by placing one hand on the medial side of the joint and forcing the ankle medially
Carry out the test as in the case of valgus stress instability, First in full extension and then in 30^0 flexion, and compare one side with the other.

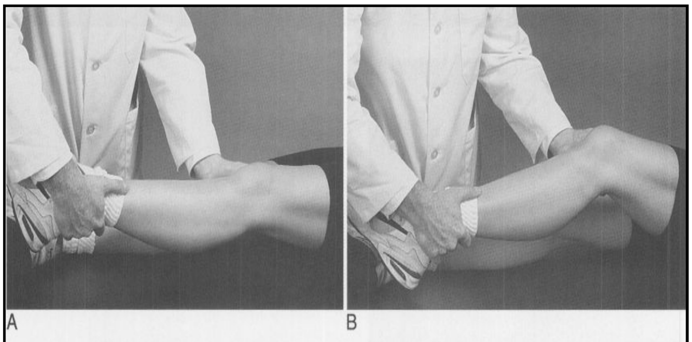


Figure 6-47. Varus stress test. A, In extension. B, In flexion.
Fig.10.28

3. Again, for a more sensitive assessment of 'give' the thumb can be placed in the joint line
If there is varus instability in extension as well as flexion, it suggests tearing of the posterior cruciate ligament as well as the lateral ligament complex.

4. As in the case of valgus stress instability, stress films maybe taken, and if examination is not possible even after aspiration, arrange to examine the knee under general anaesthesia.
5. Always check that the patient is able to dorsiflex the foot, to ensure that the motor fibers in the common peroneal nerve (lateral popliteal) have escaped damage.
6. In addition, test for sensory disturbance in the distribution of the common peroneal nerve.

The anterior drawer test

1.Flex the knee to 90^0 , see that the foot is pointing straight forwards, and steady it by sitting close to it.
Grasp the leg firmly with the thumbs on the tibial tubercle.

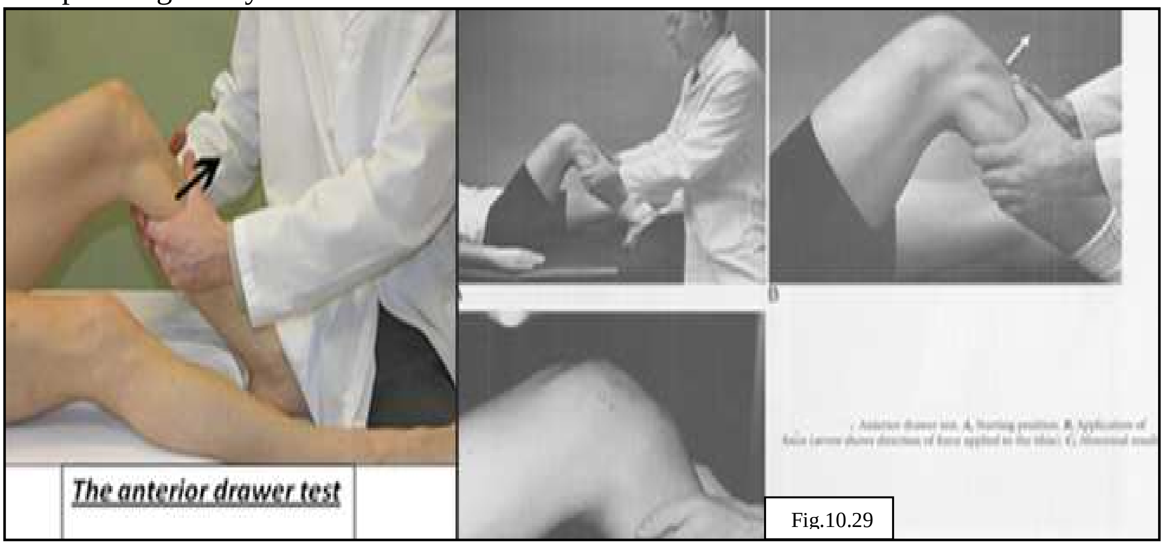


Fig.10.29

Check that the hamstrings are relaxed, and jerk the leg towards you.
repeat with the knee flexed to 70^0 , and compare the sides.
Note: significant displacement (I.e. the affected side more than the other) confirms instability of the type in which the tibia may move anteriorly from under the femur.
When the displacement is marked (say 1.5cm or ,more), then the anterior cruciate is almost certainly torn, and there is a strong possibility of associated damage to the medial complex (medial ligament and medial capsule) and even the lateral complex as well.
If the displacement is less marked and one tibial condyle move further forward than other, then the diagnosis is less clear ; it may suggest an isolated anterior cruciate ligament tear or a tibial condylar avulsion
2. repeat the test with the foot in 15^0 of external rotation
Excess excursion of the medial tibial condyle suggests antero-medial rotatory instability, with involvement of the medial ligament as well as the anterior cruciate.
Now turn the foot into 30^0 of internal rotation, and repeat the test
Anterior subluxation of the lateral tibial condyle suggests antero lateral rotational instability, with the damage of anterior cruciate ligament.
3. beware of the following fallacy : a tibia already displaced backward as a result of a posterior cruciate ligament tear may give a false positive in this test.
- This also applies to ***the lachman tests***

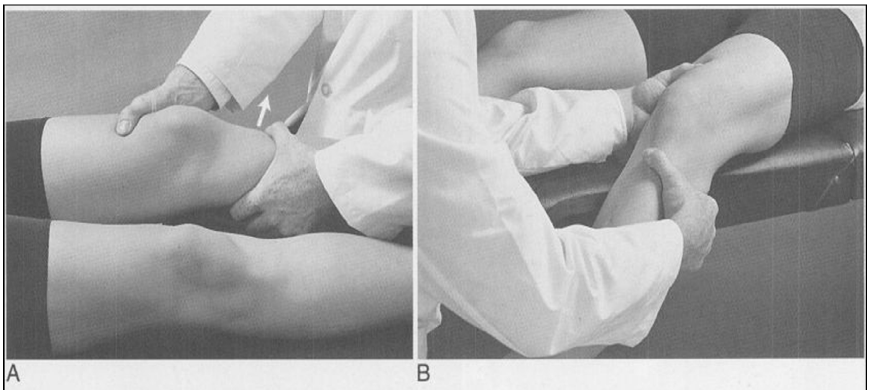
Fig.10.30

Active lachman test

The knee should be relaxed and in about 25^0 flexion
One hand stabilizes the femur, while the other tries to lift the tibia forwards.
The test is positive if there is anterior tibial movement (detected with the thumb in the joint) with a spongy end point.

Passive lachman test:

The knee is supported at 30 and the patient asked to extend it
Anterior subluxation of thye lateral tibial plateau, with posterior subluxation on relaxation also indicate a complete anterior cruciate tear.



Lachman's test. *A*, Standard position (*arrow* shows direction of force applied to the tibia). *B*, Alternative technique with the thigh supported by the exam table.

Fig.10.31 **Lachman test**

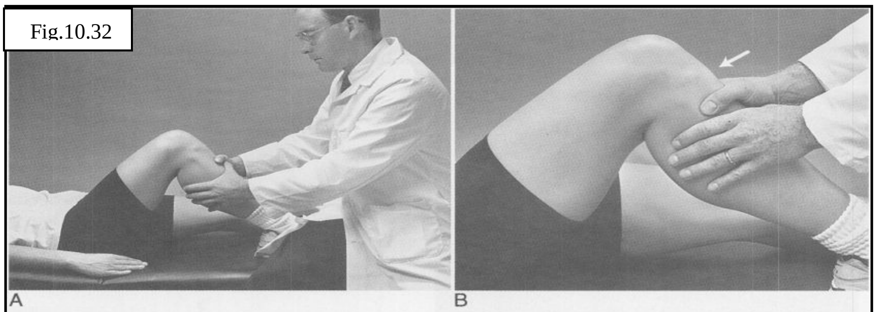
Posterior tibial displacement on instability

Rupture, detachment or stretching of the posterior cruciate ligament may permit the tibia to sublux backwards, frequently giving rise to a striking deformity of the knee which allows the diagnosis to be made on inspection alone.

Posterior drawer test

Flex the knee to 70^0 -90^0 and sit close to the foot to steady it.
Attempt to jerk the tibia backwards.
Displacement more than the other side suggests instability, and if substantial (say 1cm or more) rupture of the posterior cruciate ligament is very likely to be present.
Backward displacement of the lateral tibial condyle by a greater amount than the medial may occur in so-called postero-lateral rotatory insufficiency.

Fig.10.32



Posterior drawer test. *A,* Starting position. *B,* Application of force (*arrow* indicates direction of force applied to the tibia).

Assessing tibial subluxation (rotatory or torsional instabilities)

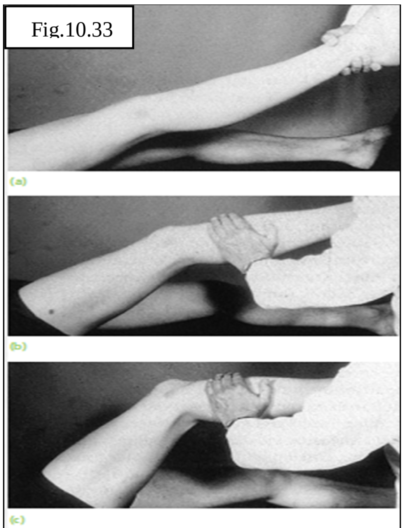
1. look for medial or lateral tenderness or oedema
2. perform the drawer test noting variations
3. test for laxity on valgus stress (usually positive in anterior subluxation of the medial tibial condyle)
4. test for laxity on varus stress (usually positive when the lateral tibial condyle subluxes forwards or backwards.

MacIntosh test for anterior subluxation of the lateral tibial condyle

Fully extend the knee while holding the foot in internal rotation

1. Apply a valgus stress
2. In this position, if instability is present, the tibia will be in the subluxed position. Now flex the knee
3. Reduction should occur at about 30 with an obvious jerk.

Fig.10.33



MacIntosh test

Losee pivot shift or jerk test for anterior subluxation of the lateral tibial condyle

The patient should be completely relaxed, with no tension in the hamstrings

Apply a valgus force to the knee

1. At the same time pushing the fibular head anteriorly
2. The knee should be partly flexed

Now extend the joint

3. As full extension is reached, a dramatic clunk will occur as the lateral tibial condyle subluxes forwards (if rotatory instability is present)

Note : the patient should relate this to the sensations experienced in activity.

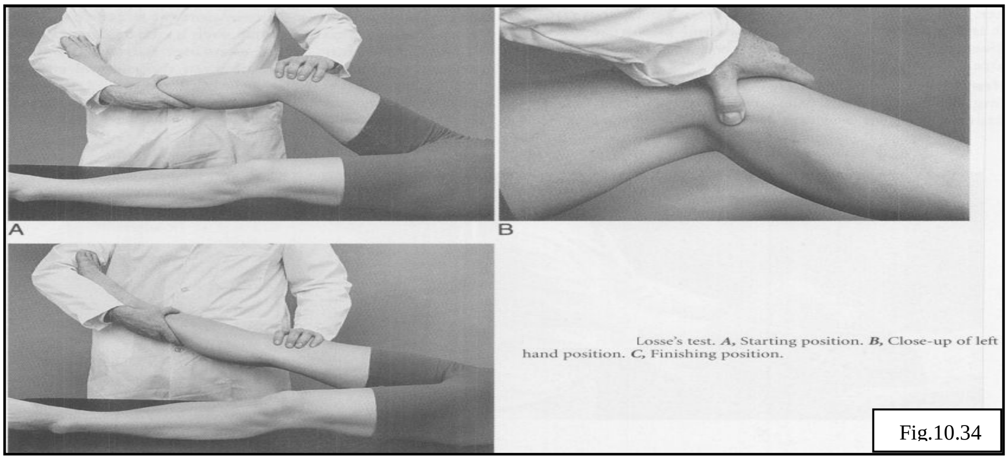


Fig.10.34

Modified pivot shift or jerk test for anterior subluxation of the lateral tibial condyle

Grasp the foot between the arm and the chest, and apply a valgus stress

1. Lean over to rotate the foot laterally
2. Now flex the knee

If the test is positive, and because the tibia is firmly held, the lateral femoral condyle will appear to jerk anteriorly
Now extend the knee, and as the tibia subluxes, the femoral condyle will appear to jerk backwards.

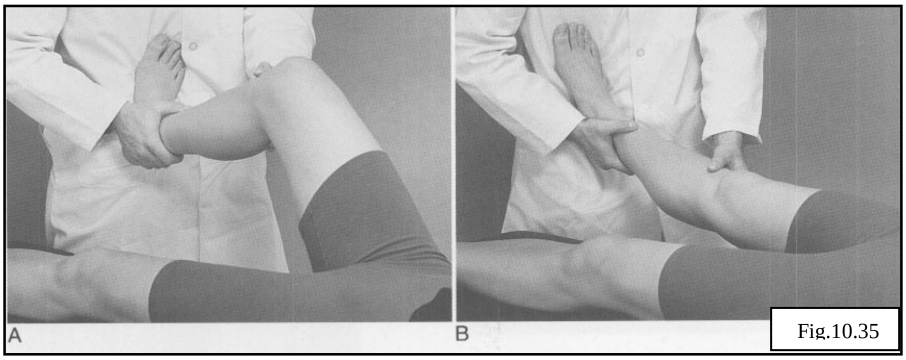


Fig.10.35

Thessaly test

Fig.10.36

This test is based on a dynamic reproduction of load transmission in the knee joint under normal or trauma conditions. With the affected knee
flexed to 20^0 degrees and the foot placed flat on the ground, the patient takes his or her full weight on that leg while being supported (for balance) by the examiner. The patient is then instructed to twist his or her body to one side and then to the other three times (thus, with each turn, exerting a rotational force in the knee) while keeping the knee flexed at 20^0 degrees.
Patients with meniscal tears experience medial or lateral joint line pain and may have a sense of locking. The test has shown a high diagnostic accuracy rate at the level of 95 per cent in detecting meniscal tears, with a low number of false positive and negative recordings.

The menisci

1. Look for tenderness in the joint line, and test for a springy block to full extension

These two signs in association with evidence of quadriceps wasting are the most consistent and reliable signs of a torn meniscus

2. In recent injuries look for tell-tale oedema in the joint line
3. ***Posterior lesions:-***
   - Fully flex the knee and place the thumb and index along the joint line
   - The palm of the hand should rest on the patella
   - You are now in a position to be able to locate any clicks emanating from the joint
   - Sweep the heel round in a U-shaped arc, looking and feeling for clicks from the joint accompanied by pain
   - Watch the patient's face, not the knee, while carrying out this test
4. ***Anterior lesions:-***
   - Press the thumb firmly into the joint line at the medial side of the patellar ligament
   - Now extend the joint
   - Repeat on the other side of the ligament
   - A click accompanied by pain, is found in anterior meniscus lesions.

5. ***McMurray maneuver for the medial meniscus***

Place the thumb and index along the joint line to detect any clicks
Flex the leg fully; externally rotate the foot, abduct the leg and extend the joint smoothly.

Fig.10.37

McMurray maneuver for the medial meniscus

6. ***McMurray maneuver for the lateral meniscus***
   Repeat the last test with the foot internally rotated and the leg adducted
   Use the hand to pick up any clicks accompanied by pain
   A grating sensation is felt in degenerative lesions.

Fig.10.38

McMurray maneuver for the lateral meniscus

7. If the clicks are detected, the normal limb should be examined to help eliminate symptomless, non-pathological clicks which may be arising from ***tendons*** or other soft tissues shapping over bony prominences (e.g***. the biceps tendon over the femoral condyle***)
8. If a unilateral painful click is obtained, repeat the test with the sensing finger or thumb removed

   The cause of the click, whether meniscus or tendon, may be visible on close inspection of the joint line .

9. <u>Meniscal cysts lie in the joint line</u>

- Feel firm on palpation, and are tender on deep pressure
- Cysts of the menisci may be associated with tears
- Lateral meniscus cyst are by far the commonest
- Cystic swellings on the medial side are sometimes due to ganglions arising from the pes anserinus (insertion of Sartorius, gracilis and semitendinosus).

Meniscal cyst (a) Typical appearance of a small, firm swelling at or just below the joint line. (b) MRI showing the cyst arising from the edge of the meniscus (arrow).

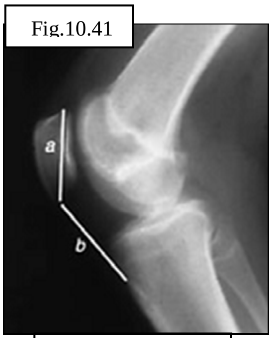
Fig.10.39

Fig.10.40

pes anserinus insertion

The Patella

Fig.10.41



patella alta

1- Examine both knee flexed over the end of the couch.
   - This may show a torsional deformity of the femur or tibia, and a laterally placed patella.
2- Look for genu recurvatum and the position of the patella relative to the femoral condyles.
   - A high patella (patella alta) is a predisposing factor in recurrent lateral dislocation of the patella.

3- Is there any knock knee deformity? Recurrent dislocation is commoner in women with this deformity.

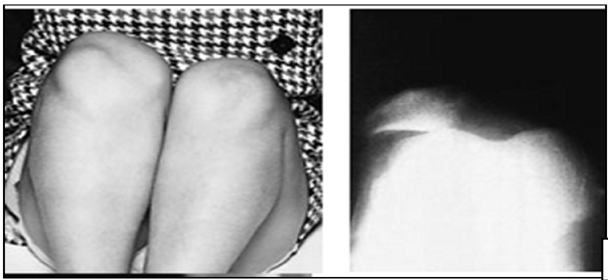


Fig.10.42

Recurrent dislocation of patella

4- Look for tenderness over the anterior surface of the patella, and note if a tender, bi-partite ridge is present.
   - Upper and lower pole tenderness occur in ***Sinding-Larsen-Johannson disease and Jumper's knee*** (extensor apparatus traction injury).
5- Displace the patella medially and palpate its articular surface.
   - Tenderness is found when the articular surface is diseased e.g. chondromalacia patellae.
   - Repeat the test, displacing the patella laterally.
   - 2/3 of the articular surface is thus accessible.
6- Test the mobility of the patella by moving it up and down and from side to side.
   - Reduced mobility is found in retro-patellar arthritis.
   - The quadriceps must be relaxed for adequate performance of this test.
7- Move the patella proximally and distally, at the same time pressing it down hand against the femoral condyles.
   - Pain is produced in chondromalacia patellae and retro-patellar arthritis.
8- Apprehension test
   - Try to displace the patella laterally while flexing the knee from the extended position.
   - The patient will be apprehensive and try to stop the examination if there is a tendency to recurrent dislocation.

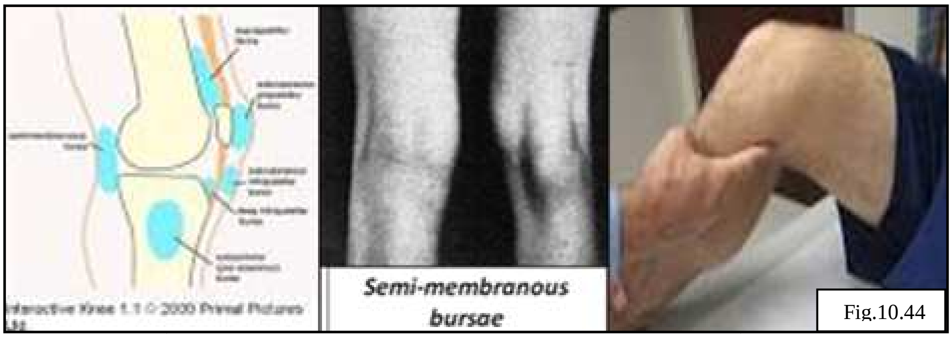
Apprehension test Fig.10.43

Articular surfaces

1- Place the palm of the hand over the patella, and the thumb and index, along the joint line.
   - Flex and extend the joint.
   - The source of crepitations from damaged articular surfaces can then be detected, compare both sides.
2- Apparent broadening of the joint and palpable exostoses occur commonly in osteoarthritis.
   - In this condition there is often laxity of the medial ligament if the medial compartment is extensively involved.

Popliteal region

1- All previous tests have involved examination of the joint from the front.
   - Examine the popliteal fossa by inspection and palpation.
   - If the knee is flexed the roof of the fossa is relaxed, and deep palpation becomes possible.
2- Semi-membranous bursae become obvious when the knee is extended.
   - Compare the sides
   - The bursa may be small at the time of examination, and transillumination is worth trying although not always positive.
   - Note that semi-membranous bursae may be secondary to rheumatoid arthritis or other pathology in the joint.



Semi-membranous bursae Fig.10.44

The Hip

Always examine the hip, especially in the presence of severe, undiagnosed pain, as hip pain is often referred to the knee joint.

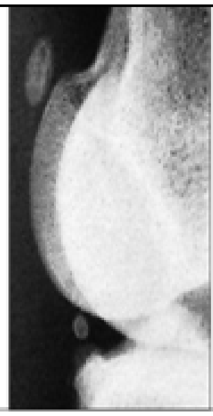
The hip may be screened by testing rotation at 90^0 flexion, noting pain or restriction of movement.

Aspiration

- Full aseptic precautions.
- Local anesthesia.
- After aspiration, apply a ***jones compression bandage***, this consists of several layers (2-4) of wool in the form of wool roll, gamgee, or cotton wool sheets, each held in place with firmly, but not tightly, applied calico, dome the or crepe.
- Note:- Gamgee is a surgical dressing consisting of a thickness of cotton wool between two layers of gauze.

X. Ray

- Anteroposterior, lateral and sometimes patella-femoral (or skyline) and intercondylar (or tunnel) views are needed.
- The anteroposterior view should be taken with the patient standing.
- It is worth while inspecting the tibiofemoral joint line, then the patellofemoral joint as separate entity.
- When a loss body is seen, its origin should be sought.
- It should not be confused with a fabella, which lies on the lateral side and behind the line joining the femur to the tibia.
- If valgus or varus has to be measured, a long film (from hip to ankle) is needed.
- Arthrography is useful in a doubtful meniscal or ligament injuries.



Which is the loose body here? Not the large one (which is a normal fabella), but th
opposite the joint line.

Fig.10.45

Arthroscopy

It is useful:-

1- To establish or relive the accuracy of diagnosis
2- To help in deciding whether to operate ,or to plan the operative approach with more precision
3- To observe and record photographically the progress of a knee disorder
4- To perform certin operative procedures

- Arthroscopy is not a substitute for clinical examination.

> ***A detailed history and meticulous assessment of the physical signs are indispensable preliminacies and remain the sheet anchor of diagnosis.***

- Full asepsis in an operating theatre is essential.

One technique is as follows :

- The patient is anaesthetized and a thigh tourniquet applied.
- Saline is injected into the joint and, through a tiny incision, a trocar and cannula introduced.
- Penetration of synovium is recognized by the flow of saline when the trocar is withdrawn.
- A fibreoptic viewer, light source and irrigation system are attached.
- All compartments of the joint are now systematically inspected
- With special instruments biopsy ,partial meniscectomy, patellar shaving and other procedures are possible
- Before withdrawing the instrument, saline is squeezed out
- A skin stitch is inserted and a firm bandage applied
- The postoperative recovery is remarkably rapid.

Classification of the disorder of the thigh and knee

Disorders of the thigh:-

Infections

- Acute osteomyelities.
- Chronic osteomyelities.
- Syphilitic infection.

Tumours

- Benign bone tumours.
- Malignant bone tumours.

Articular disorder of the knee

Arthritis

- Pyogenic
- Rh.
- T.B
- Haemophilic.
- Neuropathic.
- Chondromalacia of the patella.

Mechanical disorders

- Tears of the meniscus.
- Cysts of the meniscus.
- Discoid of the meniscus.
- Osteochondritis dissecans.
- Intra-articular loose bodies.
- Recurrent dislocation of the patella.
- Habitual dislocation of the patella.

Extra-articular disorder in the region of the knee.

Deformities

- Genu varum.
- Genu valgum.
- Genu recurvatum.

Injuries

- Rupture of quadriceps apparatus.
- Apophysitis of the tibial tubercle (Osgood-Schlatters disease).

Post traumatic ossification

- Pellegrini-Stieda's disease of the medial femoral condyle.

Fig.10.46

Pellegrini-Stieda's Disease.

Integrity of the knee joint

Brantigan and Voshell (1941), from a study of amputation specimens, indicated that the Integrity of the knee joint depends upon the muscles and tendons about the knee, the articular capsule, intrinsic ligaments of the joint and the bone architecture of the tibia and femur.

- They established the following facts regarding stablitiy:-

1- Lateral motion of the knee joint in extension is controlled by the
   - Capsule.
   - Collateral ligaments.
   - Cruciate ligaments.

   In flexion by the same structures minus the fibular collateral ligament.

2- Rotator motion of the knee joint in extension is controlled by the
   - Capsule.
   - Collateral ligaments.
   - Cruciate ligaments.

   In flexion by the same structures minus the fibular collateral ligament.

3- Forward gliding of the tibia on the femur is controlled by the anterior cruciate ligament.

4- Backward gliding of the tibia on the femur is controlled by the posterior cruciate ligament.

5- Lateral gliding of the tibia on the femur is controlled by the tibial intercondyloid eminence and the femoral condyles with the aid of all the ligaments.

6- Hyperextension is controlled by
   - Both collateral ligaments.
   - Both menisci.
   - The posterior aspect of the articular capsule.
   - The oblique popliteal ligament.
   - The articular surface of the femoral condyles.

7- Hyperflexion is controlled by
   - Both cruciate ligaments.
   - Both menisci.
   - The femoral attachment of the posterior aspect of the capsule.
   - The femoral attachment of both heads of the gastrocnemius muscle.
   - The bone structure of the condyle of the femur and the tibia.

8- The menisci cushion hyperextension and hyperflexion

- The tibial collateral ligament is closely related to the medial meniscus, but there is no strong fibrous tissue attachment between them.
- The tibial collateral ligament glides downward and backward in extension and flexion.

Joint Stability

Knee stability is provided by muscle and ligaments which act as :-

1- ***Static stabilizers***

a- Capsule and capsular ligaments.

b- Extra-capsular ligaments.

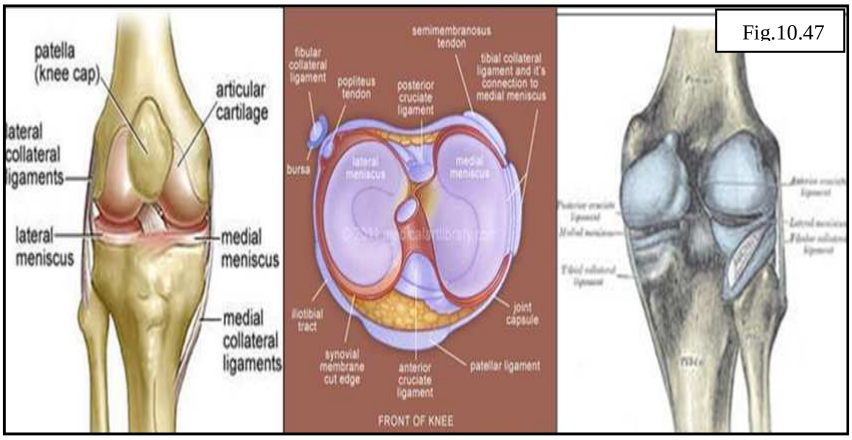


Fig.10.47

2- ***Dynamic stabilizers***

Musculotendinous units and their apponeurosis,

- But protective reflex act too slowly to prevent many injuries.

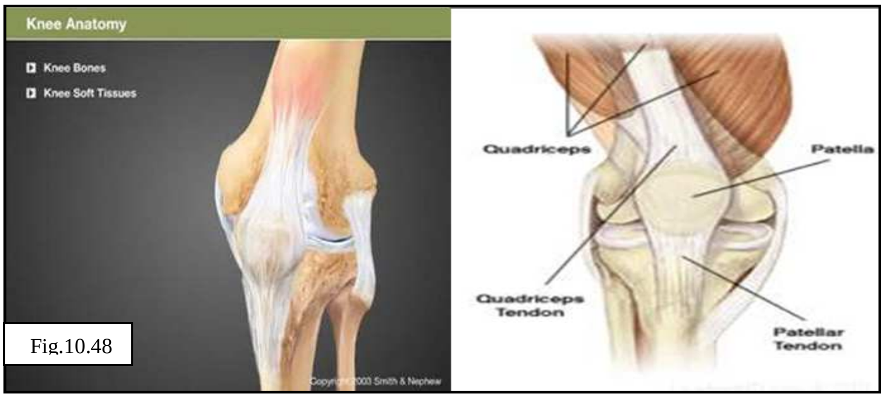


Fig.10.48

Medial Collateral Ligament

- Phylognetically this is a continuation of the insertion of adductor magnus.
- The superficial part is not attached to the tibia unit 4.5cm below the joint.

- The medial inferior geniculate vessels and a bursa pass beneath this and it allow tibial rotation.
- This is more often torn in the hyperextended knee which cannot unlock rapidly.
- The deeper laying structure is attached to the medial meniscus- a little behind its mid-point and has much shorter and stronger fibers.

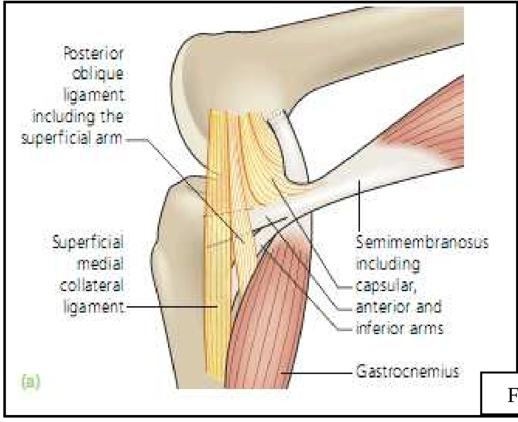


Fig.10.49

Lateral Collateral Ligament

- Phylognetically this is the origin of peroneus longus and is quite rounded and cord-like.
- It stretches between the femur and the tip of fibula.
- It is separated from the lateral meniscus by popliteus tendon.

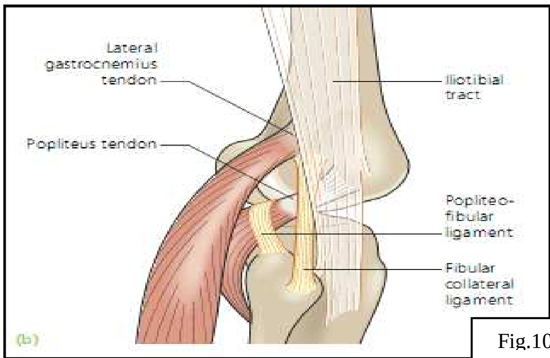
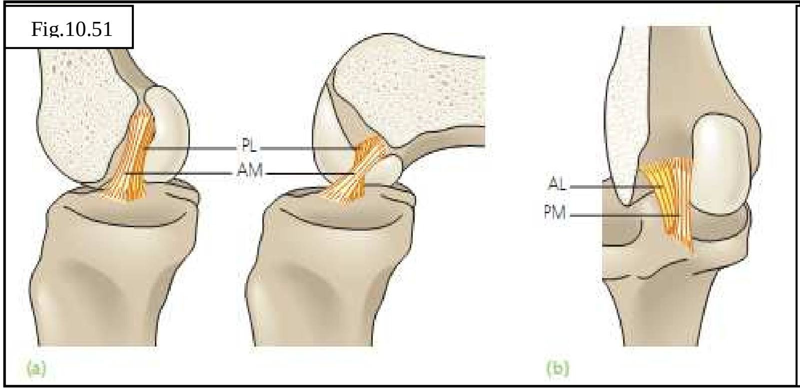


Fig.10.50
Fig.10.50

Anterior Cruciate Ligament

- Form a cord like origin on the anterior tibial plateau, fibers turn through 90^0 to a fan-like insertion.
- Its mechanism is to stabilize internal rotation and extension of the tibia.
- Its function is multiple, in that it limits forward gliding of tibia on femur and limits hyperextension.
- It makes a significant contribution to lateral stability and limits rotation of tibia of femur in extension.
- Smillie (1978) has stressed the role of guiding the tibia in the 'screw home' mechanism, and blocksto this may cause an "Isolated" tear.

Fig.10.51



Dual-bundle structure of the anterior and posterior cruciate ligaments
(a) The anteromedial (AM) bundle of an anterior cruciate ligament is taut in 90° of knee flexion whereas the posterolateral (PL) bundle tightens in extension.
(b) In contrast, it is the anterolateral (AL) bundle of the posterior cruciate ligament that is tight in 90° flexion and the posteromedial (PM) bundle tightens in extension (and therefore resists hyperextension).

Posterior Cruciate Ligament

- This is the stoutest ligamentous structure.
- Kennedly showed it to be twice as strong as the anterior cruciate or the tibial collaterals.
- Isometrically it is under tension throughout the whole range of movement.
- Its function are to limit backward glide of tibia on femur and hyperextension.
- It tightness in internal rotationof tibia on femur.
- Hughston (1976) have stressed that it is the fundamental stabilizer of the knee, being at the axis of flexion extension and rotation.

The knee

X-Rays:

Anteroposterior and lateral views are routine; it is often useful also to obtain tangential ('skyline') patello-femoral views and intercondylar (or tunnel) views. *The anteroposterior view should always be taken with the patient standing*; unless the femoro-tibial compartment is loaded, narrowing of the articular space may be missed. Both knees should be x-rayed, so as to compare the abnormal with the normal side.

Tibio-femoral alignment: can be measured on fulllength standing views. Normal indices have also been established for patellar height and patello-femoral congruence.

Fig.10.52

X-rays Anteroposterior views should always be taken with the patient standing. (a,b) X-rays with the patient lying down show only slight narrowing of the medial joint space on each side; but with weightbearing (c,d) it is clear that these changes are much more marked.

THE DIAGNOSTIC CALENDAR:

While most disorders of the knee can occur at any age, certain conditions are more commonly encountered during specific periods of life.

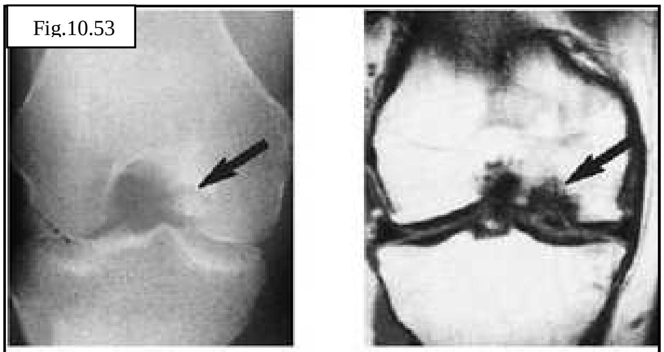
Congenital knee disorders: may be present at birth or may become apparent only during the first or second decade of life.

Adolescents: with anterior knee pain are usually found to have chondromalacia patellae, patellar instability, osteochondritis or a plica syndrome. But remember – knee pain may be referred from the hip!

Young adults: engaged in sports are the most frequent victims of meniscal tears and ligament injuries. Examination should include a variety of tests for ligamentous instability that would be quite inappropriate in elderly patients.

Patients above middle age: with chronic pain and stiffness probably have osteoarthritis. With primary osteoarthritis of the knees, other joints also are often affected; polyarthritis does not necessarily (nor even most commonly) mean rheumatoid arthritis.

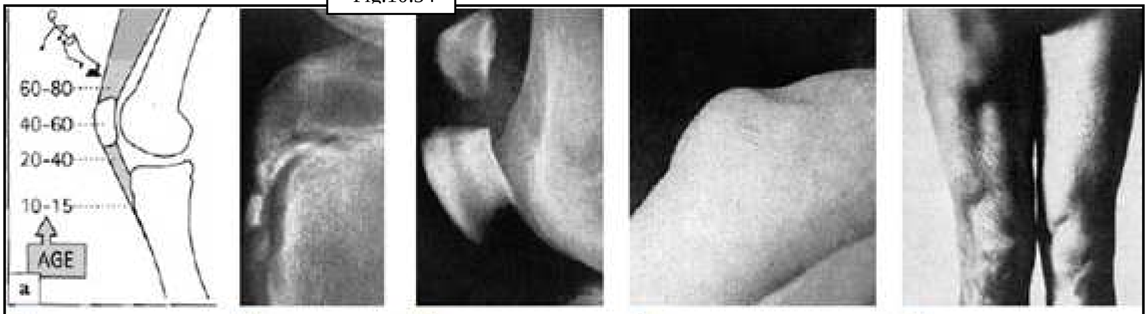
Fig.10.53



(a) (b)

Osteochondritis dissecans – imaging The lesion is often missed in the standard anteroposterior x-ray and is better seen in the 'tunnel view', usually along the lateral side of the medial femoral condyle (a). Here the osteochondral fragment has remained in place but sometimes it appears as a separate body elsewhere in the joint. (b) MRI provides confirmatory evidence and shows a much wider area of involvement than is apparent in the plain x-ray.

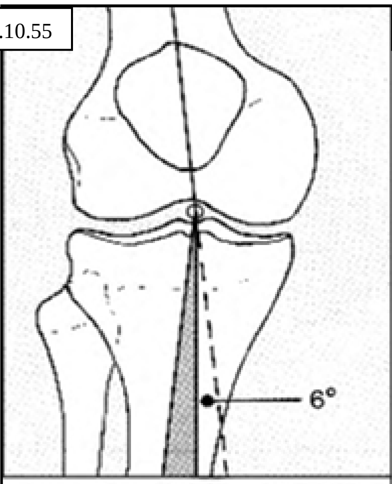
Fig.10.54



(a) (b) (c) (d) (e)

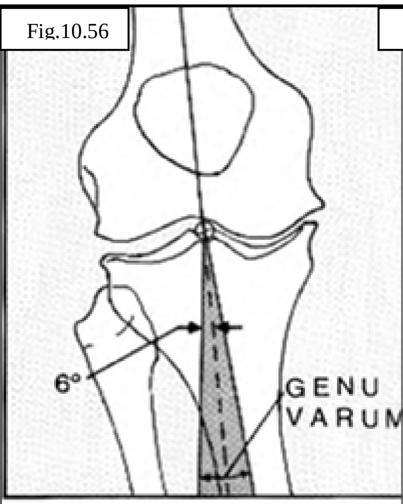
Extensor mechanism lesions These follow resisted action of the quadriceps; they usually occur at a progressively higher level with increasing age (a). (b) Osgood-Schlatter's disease – the only one that usually does not follow a definite accident; (c) gap fracture of patella; (d) ruptured quadriceps tendon (note the suprapatellar depression); (e) ruptured rectus femoris causing a lump with a hollow below.

Fig.10.55



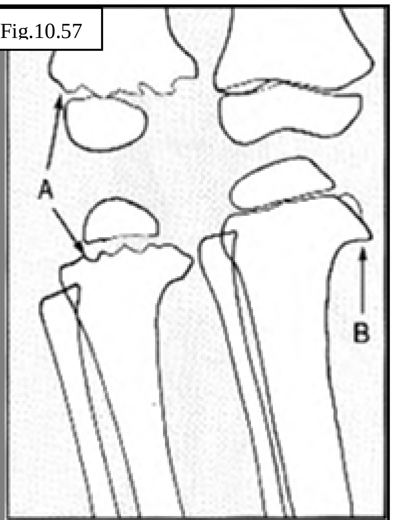
Genu valgum in adults: The degree of valgus may be roughly assessed by measuring the angle formed by the tibial and femoral shafts. Allow for the 'normal' angle, which is approximately 6° in the adult. The shaded area represents genu valgum. (Note that the tibiofemoral angle is virtually the same as the Q angle used in the assessment of patellar instability.)

Fig.10.56



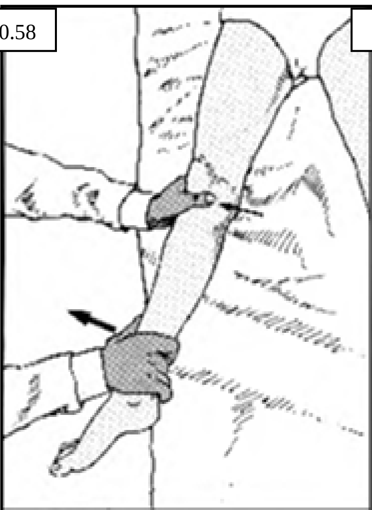
Genu varum An assessment of the deformity may also be carried out with X-rays, as in genu valgum, with the patient weightbearing during the exposure of the films. The deformity is seen most commonly in osteoarthritis and Paget's disease. It may occur in rheumatoid arthritis, although genu valgum is commoner in that condition.

Fig.10.57



. **Genu varum** In children, radiography may be helpful. In (A) *rickets*, note the wide and irregular epiphyseal plates. In (B) *tibia vara*, note the sharply downturned medial metaphyseal border. Note that radiological varus is normal till a child is 18 months old.

Fig.10.58

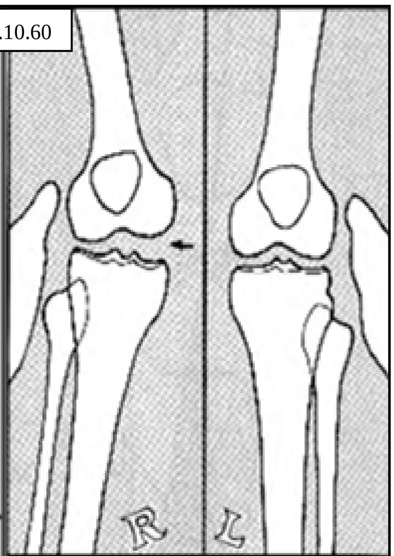


. **Valgus stress instability** If in doubt, use the heel of the hand as a fulcrum and use the thumb or index, placed in the joint line, to detect any opening up of the joint as it is stressed. If there is still some uncertainty, compare the two sides.

Fig.10.59

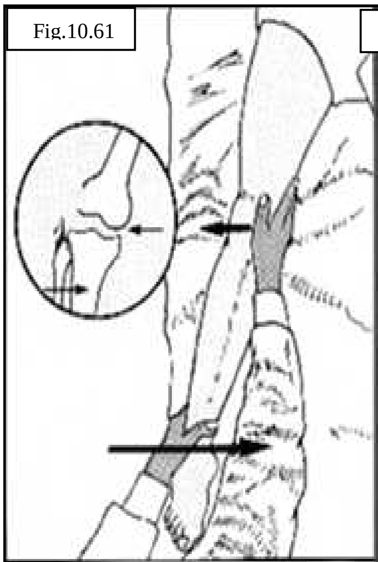
Valgus stress instability stress films (1): If there is still some doubt, then radiographs of both knees should be taken while applying a valgus stress to each joint.

Fig.10.60



. **Valgus stress instability stress films (2):** The films of both sides are then compared. Any instability should be obvious.

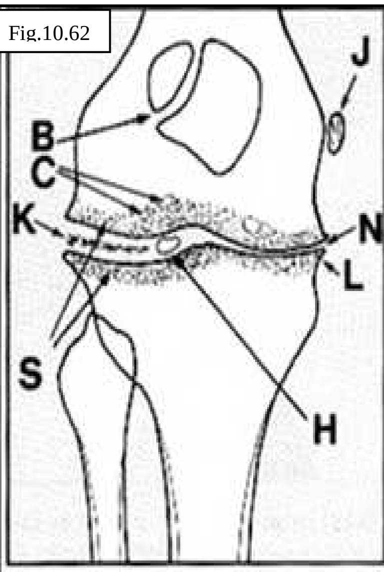
Fig.10.61



. Varus stress instability

Attempt to produce a varus deformity by placing one hand on the medial side of the joint and forcing the ankle medially. Carry out the test as in the case of valgus stress instability, first in full extension and then in 30° flexion, and compare one side with the other. Note that when testing the lateral ligament, in the normal knee there is a little more 'give' than with the medial.

Fig.10.62



Radiographs : Note any joint space narrowing (indicating cartilage loss) (N), lipping (L), marginal sclerosis (S), cysts (C), loose bodies (H), varus or valgus (these are all common in osteoarthritis). Do not mistake a bipartite patella (B) for fracture; bipartite patella, if present, affects the *outer* quadrant). Note any abnormal calcification, as in Pellegrini-Steida disease (J), calcified meniscus (K), and pseudogout.

Fig.10.63

Blount's disease In contrast to the children in Fig 20.15, this young boy developed progressive bow-legged deformities from the time he started walking. X-rays showed the typical features of Blount's disease: marked distortion of the tibial epiphysis, as if one half of the growth plate (physis) had fused and stopped growing. Changes can be accurately assessed by measuring the *metaphyseo-diaphyseal angle*: a line is drawn perpendicular to the long axis of the tibia and another across the metaphyseal flare as shown on the x-ray; the acute angle formed by these two lines should normally not exceed 11°.

Chapter 11
The Ankle and Foot

Inspection

1- Look for

a- Deformity of shape, suggesting recent or old fracture.

b- Sinus scars, suggesting old infection, particularly T.B.

2- Look for the deformity of the posture (e.g. plantar-flexion from short tendo calcaneus, talipes deformity, rupture tendo calcaneus or drop foot).

3- Look for bruising, swelling or oedema, if there is any swelling, note is it diffuse or localized.

- Look also if oedema is bilateral, suggesting a systemic rather than a local cause.

Palpation

Tenderness

1- When there is tenderness localized over the malleoli following injury, X.Ray is necessary to exclude fracture.

2- After inversion sprains, tenderness is often diffuse.

- Swelling to begin with, lies in the line of fascia of the lateral ligament.

Lateral ligament

1- Complete lateral ligament tear :-

Swelling is rapid, and if seen within two hours of injury, is egg shaped and placed over the lateral malleolus.

2- Stress test (for complete tears- grasp the heel and forcibly invert the foot, feeling for any opening-up of the lateral side of the ankle between tibia and talus.

3- If in doubt, have a radiograph taken while the foot is forcibly inverted.

4- If tilting of the talus in the ankle mortice is demonstrated.

- Repeat the examination of the other side and compare the films.

5- If the injury is fresh and painful, the examination may be more readily permitted after injection of 15-20 ml of 1% lignocaine widely in the region of the lateral ligament.

6- Instability may sometimes follow tears of the anterior talo-fibullar portion only of the lateral ligament, and may be confirmed by radiographs after local anesthesia.

- Support the heel on a sandbag and press firmly downward on the tibia for 30 seconds up to exposure.

-A gap between the talus and tibia of > 6mm regarded as pathological.

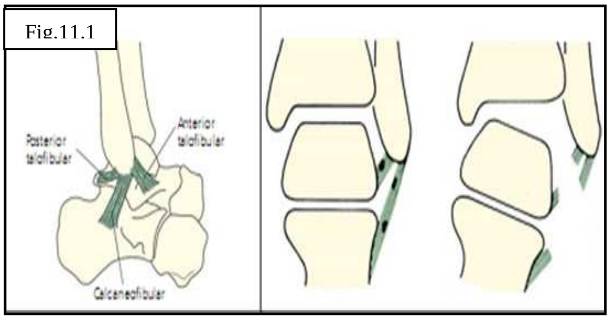


Fig.11.1

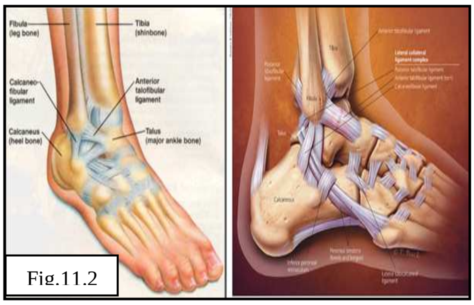


Fig.11.2

Inferior tibio – fibular ligament

1- In tears of this ligament (which has anterior and posterior components) tenderness is present over the ligament just above the line of the ankle joint.
2- In tear of the ligament, pain is produced by dorsi – flexion of the foot which displaces the fibula laterally.
3- Grasp the heel and try to move the talus directly laterally in the ankle mortice
   - Lateral displacement indicates a tear of the ligament.

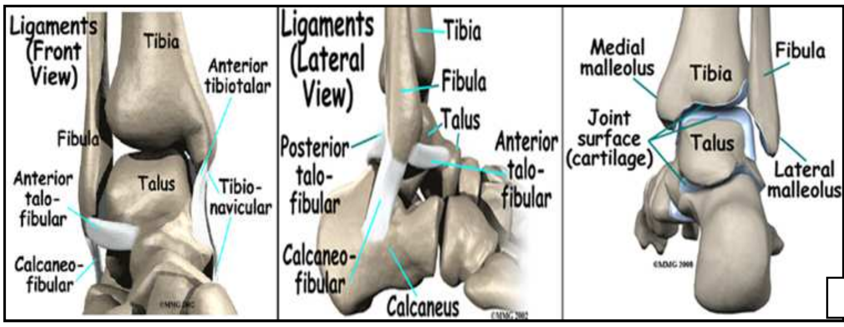


Fig.11.3

Movments

1- First confirm that the ankle is mobile, and that any apparent movement is not arising in the mid-tarsal or more distal joint .
2- Measure planter flexion from the zero position
   -this reference is at right angles to the line of the leg
   - -normal range = 55.
3- Measure the rang of dorsiflexion =15.
4- If dorsiflexion is restricted, bend the knee
   -If this restores a normal range, the Achilles tendon is tight .
   -if it makes no difference, joint pathology (such as osteo – arthritis, rheumatoid arthritis or infection) is the likely cause .

5- if there is loss of active dorsiflexion (dropfoot) full neurological examination is required
   - The commonest causes are stroke, old polio, prolapsed lumbar disc and local lesions of the common peroneal (lateral popliteal) nerve.

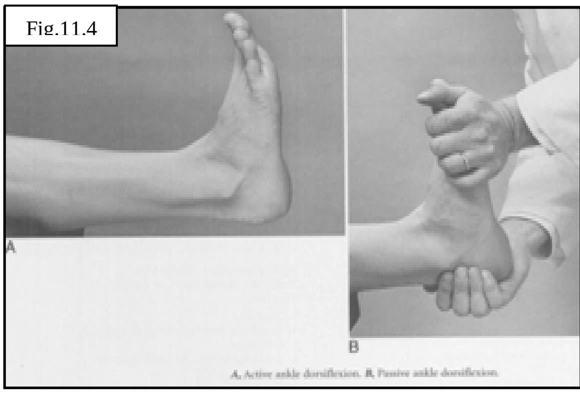


Fig.11.4

A, Active ankle dorsiflexion. B, Passive ankle dorsiflexion.

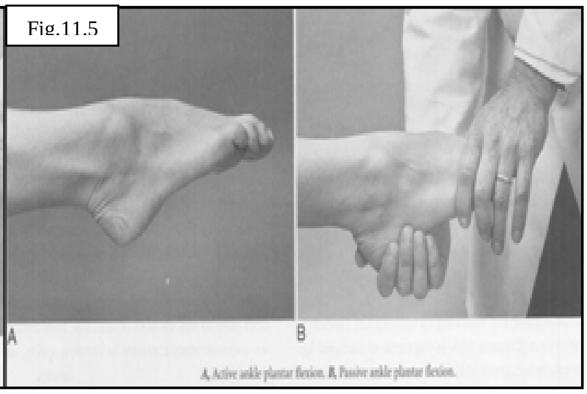


Fig.11.5

A, Active ankle plantar flexion. B, Passive ankle plantar flexion.

<u>Tendo calcaneus (Achillis tendon)</u>

1- The patient should be prone, with the feet over the edge of the couch.

- Defects in the contour of the tendon may be obvious.

Note any enlargement of the bursa related to the tendon.

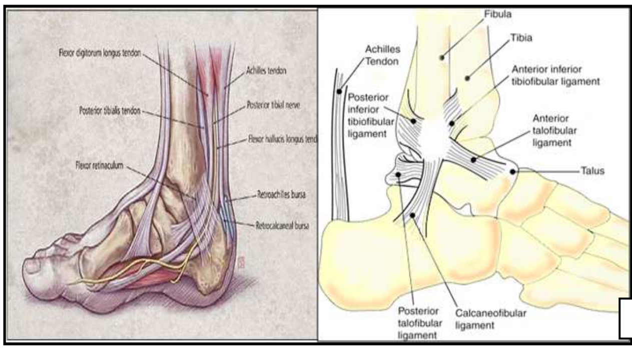


Fig.11.6

2- Test the power of plantar flexion by asking the patient to press the foot against your hand.

- The calf squeeze test (Thompson™s or Simmond™s test) is diagnostic of Achilles tendon rupture: normally, with the patient prone, if the calf is squeezed the foot will plantarflex involuntarily; if the tendon is ruptured the foot remains still.
- Clinical assessment is often sufficient. Ultrasound scans must be used to confirm or refute the diagnosis.

Simmonds test: both calves are being squeezed but only the left foot plantarflexes the right tendon is ruptured.

Fig.11.7

3- Palpate the tendon while the patient continues resisted plantar-flexion.

- Compare the sides.
- Any gap in the tendon (rupture tendo calcaneus) should be obvious.

- The integrity of the tendon may also be tested by inserting a needle vertically into the middle of the calf.
- Normally the needle should tilt when the ankle is passively dorsiflexed and plantar-flexed.

Tenosynovitis

1- Medial:- look for tenderness along the line of the long flexor tendons.

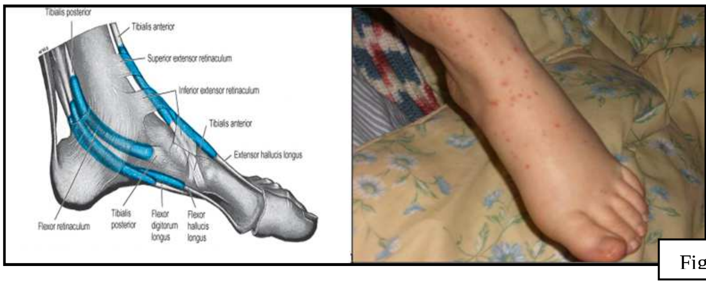


Fig.11.8

- Tenderness is usually diffuse and linear in pattern.
- Note any local thickening.

2- Look for synovitis in relation to the flexor tendons.
- There may be obvious swelling.
- Demonstrate excess fluid by milking the tendon sheaths proximally.

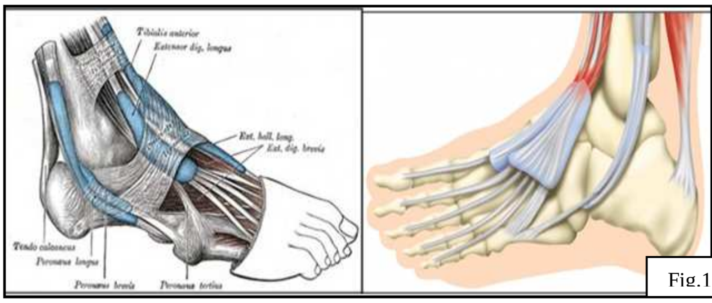


Fig.11.9

3- Plantar-flex and evert the foot
- This may produce pain where teno-synovitis involves the tendon of tibialis posterior.

4- With the foot held in the plantar-flexed and everted position, look tenderness or gaps (spontaneous rupture) in the line of the tendon of tibialis posterior.
- Spontaneous rupture is seen most frequently in flat foot and rheumatoid arthritis.

5- Lateral:- examine the peroneal tendon for tenderness and the presence of excess synovial fluid in their sheaths.

6- Force the foot into plantar-flexion and inversion.
- This will give rise to pain and increase tenderness along the line of the peroneal tendons if teno-synovitis of the peroneal tendons is present.

<u>Peroneal tendons</u>

- Lightly palpate the peroneal tendons with the fingers.
- Look and feel for displacement of the tendons as the patient evert the foot against light resistance.
- Displacement occurs in the condition known as (snapping peroneal tendons).

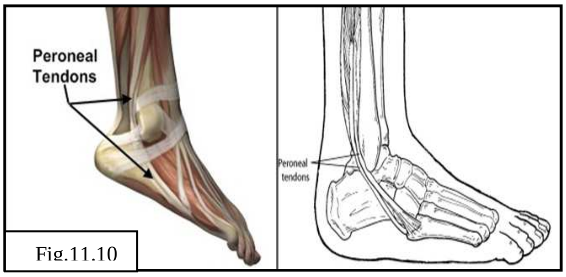


Fig.11.10

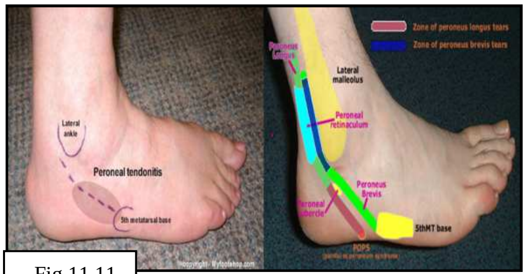


Fig.11.11

Articular surfaces

1- Forcibly plantar-flex the foot to allow palpation of part of the articular surface of the talus.
   - Tenderness occurs in arthritic conditions, and in osteochondritis of the talus.

Fig.11.12

   - A tender exostosis may be palpable in footballer's ankle.


Fig.11.13

2- Place a hand across the front of the ankle and passively dorsiflex and plantar-flex the foot.
   - Crepitations suggest articular damage.

Physical Examination

Appearance:-

- Note the shape of the foot and the presence of any obvious deformities, abnormal callus formation.

Weight-bearing posture

- Examine the Weight-bearing foot, from above, from behind and from sides.

Palpation

- Look for tenderness.
- Note any joint crepitations.
- Note any increase or decrease in skin temperature.

Movement

- Examine the mobility of the toes, foot and ankle.

Gait

- Examine the gait, with and without shoes.
- If indicated, screen the ankles, knee, hips, spine, CNS and circulation.
- Note the footprint and examine the shoes.

Fig.11.14

Investigations

- Study the results of special investigations, e.g. radiographs, serum uric acid, ESR, Rose-waaler test, etc.

Inspection

General

- Note if the foot is normally proportioned, if not, look at the hands and assess the rest of skeleton.
- The feet, for example are long and thin in Marfan's syndrome (arachodactyly, spider bones).

Fig.11.15

Heel

- Is there a calcaneal prominence (calcaneal exostosis) with overlying callus or bursitis.

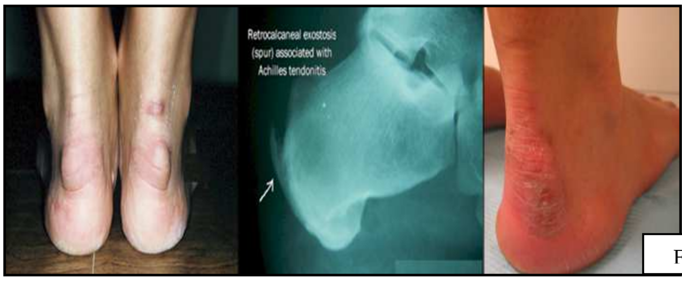


Fig.11.16

- Is there deformity of the heel suggesting old fracture, talipes deformity.

Fig.11.17

Dorsum

1- Is there prominence of the fifth metatarsal bone.

- An exostosis from prominence of the fifth metatarsal head (both are sources of local pressure symptoms).

Fig.11.18

2- If there

a- Cuneiform exostosis?

Fig.11.19

b- A dorsal ganglion?

Fig.11.20

3- Note the general state of the skin and nails.

- If there is any evidence of ischemia, full examination is required.
- In all cases the presence of dorsalis pedis pulse should be sought routinely.

Great toe

1- Note any hallux valgus deformity.

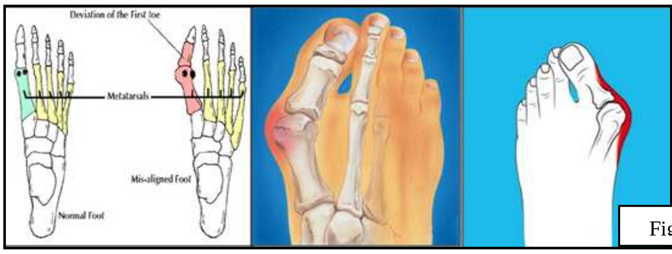


Fig.11.21

- If the deformity is severe, the great toe may under or over-ride the second and it may promote.

Fig.11.22

- The second toe may sublux at the M.P joint.
- Always re-assess any valgus deformity with the foot weight-bearing.

2- Note the presence of any bursa over the M.P joint (bunion) and whether active inflammatory changes are present (from friction or infection).

Fig.11.23

- Discoloration of the joint with acute tenderness is suggestive of Gout.

Fig.11.24

3- Note if

a- The great toe is thickened at the M.P joint, suggesting hallux rigidus, or

Fig.11.25

b- Held in flexed position (hallus flexus).

Fig.11.26

4- Note the presence of excess callus under the great toe.

- This is suggestive of hallux rigidus.

Fig.11.27

<u>Great toe nail</u>

- Note if the great toe nail is

a- Deformed (onychographosis).

b- Ingrowing possibly with accompanying inflammation.

Fig.11.28


Fig.11.29

c- Elevated (suggested subungual exostosis).


Fig.11.30

d- Of uneven texture and growth (suggesting fungal infection or psoriasis).


Fig.11.31

Toes

1- Note the relative lengths of the toes.
   - A second toe longer than the first may occasionally become clawed or throw additional stresses on its M.P joint.
2- Flex the toes and note the relative lengths of the metatarsals.
   - Abnormally short first or fifth metatarsals are potentially cause of forefoot imbalance and pain.
   - When both are short, there is often painful callus under the second metatarsal.
3- Clow toes. Are all the toes extended at the metacarpophalangeal joints and flex at the interphalangeal joints (clow toes), suggesting pes cavus or intrinsic muscle insufficiency ?

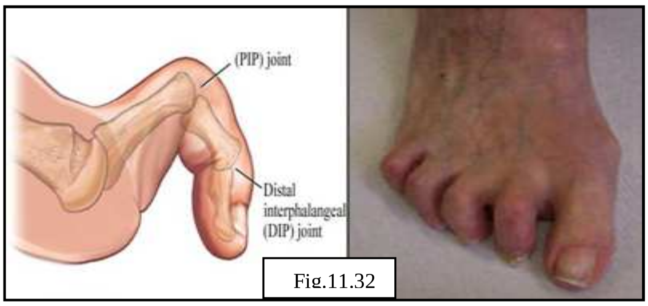


Fig.11.32

4- Is there a hammer toe deformity (toe flexed at the proximal interphalangeal joint)?

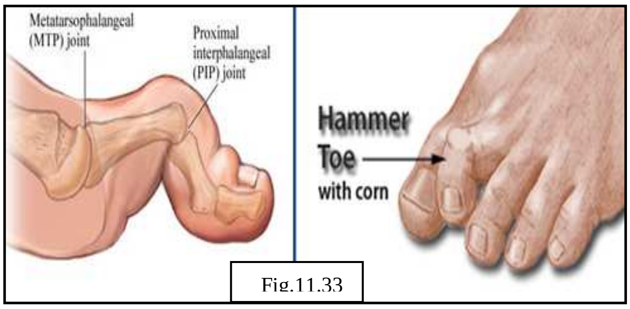


Fig.11.33

The second toe is most commonly affected, often with an associated hallux valgus deformity

There is usually calus over the prominent interphalangeal joint from the shoe pressure

5- Note the presence of

A- mallet toe deformity (flexion deformity of the distal interphalangeal joint)

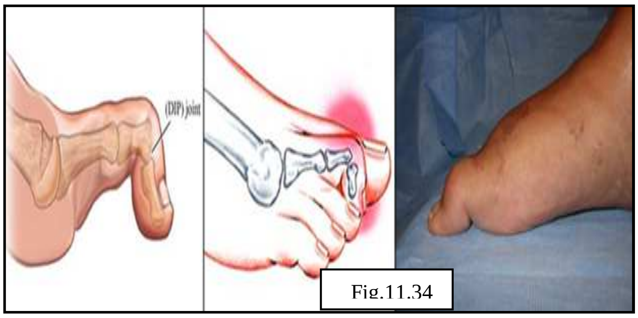


Fig.11.34

- There is usually calus under the tip of the toe or deformity of the nail.

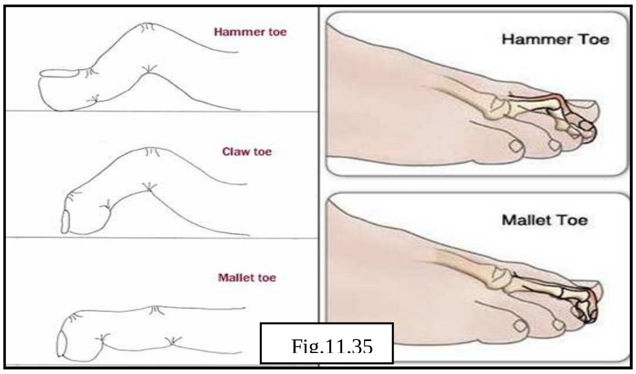


Fig.11.35

B- an overlapping fifth toe or quinti varus deformity (often congenital).


Fig.11.36

6- Note the pressure of

a- Hard corns.

- There are areas of hyperkeratosis which occur over bony prominence, generally through pressure against the shoes.

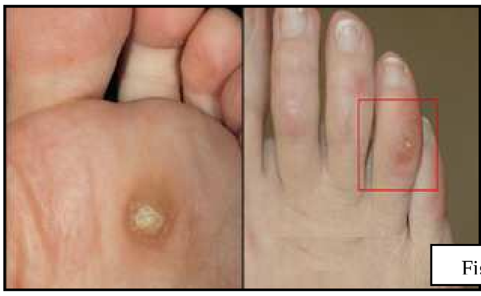


Fig.11.36

b- soft corns are macelated hyperkeratosis lesions occurring between the toes.

Fig.11.37

sole

1- Note

A- Hyperhidrosis.

B- Evidence of fungal infection or athlete's foot.

Fig.11.38

Fig.11.39

C- Ulceration of sole suggesting pes cavus or neurological. disturbance.

2- Note the presence of callus, indicating uneven or restricted area of weight bearing .

- Be careful to distinguish between abnormal, local thickening, and diffuse, moderate thickening at the heel and under the metatarsal heads which is normal

3- Note the presence of a verruca (plantar wart).

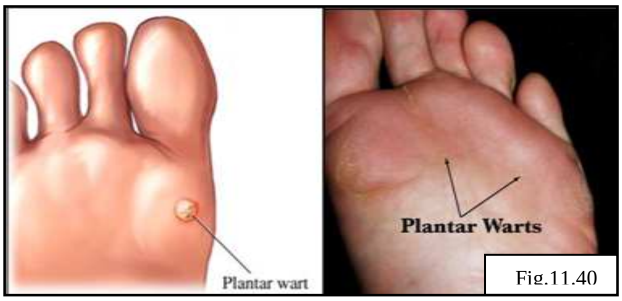


Fig.11.40

- Note the three classical sites at the heel, under the great toe, and in the forefoot in the region of metatarsal heads
- In the sole they are situated between the metatarsal heads; unlike callus, they do not occure in pressure areas.
- A verruca is exquisitely sensitive to side to side pressure.
- Calluses are much less sensitive, and only to direct pressure.
- A magnifying lens may be used to confirm the central papillomatous structure of the verruca if there is any remaining doubt.

4- Note any localized fibrous tissue mass in the sole, arising from the plantar fascia and attached to the skin, occurring in Dupuytren's contracture of the feet
   - Always inspect the hands as both the upper and lower limbs are often involved together.

Posture

1- Examine the patient standing.
   - Are both the heel and forefoot squarely on the floor (plantigrade foot)?
   - If the heel does not touch the ground, examine ofr shortening of the leg, or shortening of the tendo-calcaneus.

2- Intoeing –

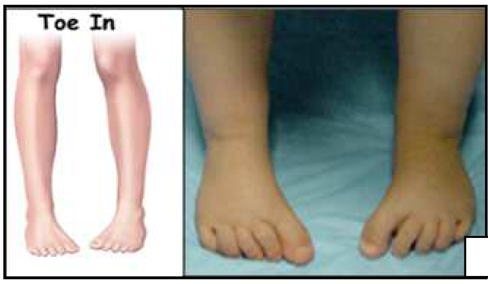


Fig.11.41

   - if this deformity is present, examine for

a- Torsional deformity of the tibia.

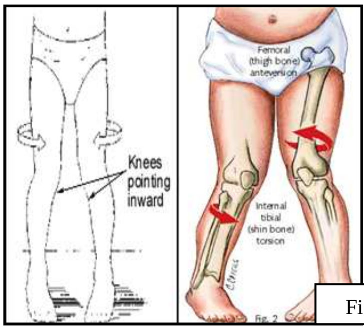


Fig.11.42

b- Increased internal rotation of the hips.

c- Adduction of the forefoot.

   - Most cases of intoeing in children resolve spontaneously by age 6.

Fig.11.43

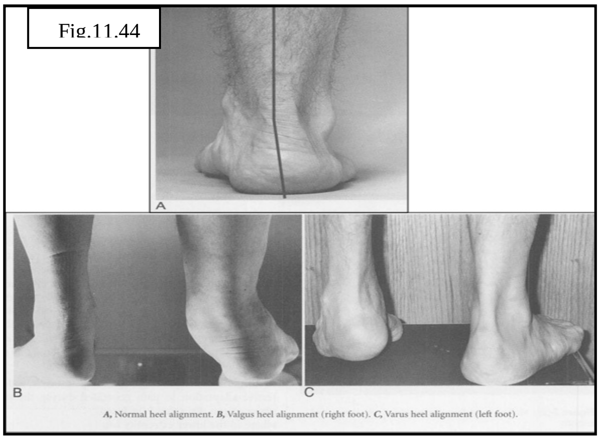


Fig.11.44

A, Normal heel alignment. B, Valgus heel alignment (right foot). C, Varus heel alignment (left foot).

3- Genu valgum

Note the presence of genu valgum wich is frequently associated with valgus flat foot

4- Eversion : if the foot is everted, this suggests

a- Peroneal spastic flat foot.

b- A painful lesion of the lateral side of the foot.

c- If less marked, pes planus.

5- Inversion

- If the foot is inverted this suggests

a- Muscle imbalance from stroke or other neurological disorder.

b- Hallux flexus or rigidus.

c- Pes cavus.

d- Residual talipes deformity.

e- Painful condition of the forefoot.

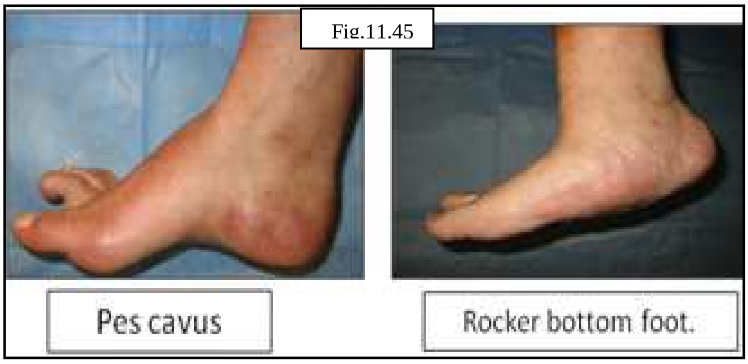


Fig.11.45

6- Splaying : Note if there is broadening of the forefoot.

- This is often the result of intrinsic muscle weakness; and may be associated with pes cavus, callus under the metatarsal heads, hallux valgus, anterior metatarsalgia and trouble with shoe fitting.

7- The toes : Reassess the toe for clawing, mallet toes and hammer toes.

- Re-assess the great toes particularly for the degree of hallux valgus and over-riding of adjacent toe(s)

8- Medial arch

1- Look at the arch and try to assess its height

- Try to slip the fingers under the navicular..
- In pes cavus, the finger may penetrate a distance of 2 cm or more from the cervical edge of the foot.

2- If pes cavus is suggested, look for confirmatory clawing of the toes, callus or ulceration under the metatarsal heads, and ulceration of the foot-print.
3- If pes cavus is present, carry out a full neurological examination.
   - Look at the lumbar spine of dimpling of the skin, a hairy patch, or pigmentation suggesting spina bifida, or neurofibromatosis.
   - Radiography of the lumbar is desirable.
4- In pes planus, the medial arch is obliterated.
   - The navicular is often prominent, and the fingers cannot be inserted under it.
   - Ask the patient to attempt to arch the foot
   - In mobile flat foot the arch can often be restored voluntarily
5- If pes planus is suspected, re-examine the sole for evidence of an increase in the area of weight-bearing
   - The footprint will be abnormal in these circumstances
   - Note also the pressure of any knock-knee deformity
6- Pes planus

Assess the mobility of the foot first by asking the patient to stand on the toes, at the same time examining the alteration in the shape of the foot by sight and feel.

- Later in the examination carefully note inversion and eversion range

<u>Heel</u>

1- Look at the foot from behind, paying particular attention to the shape of the heels.

Note :

a- Valgus heels are associated with pes planus.
b- Varus heels are associated with pes cavus.
2- Again ask the patient to stand on the toes, observing the heels.
   - If the heel posture corrects, this indicates a mobile sub-talar joints.
   - When the heel is valgus it may suggest shortening of the tendo-calcaneus.

<u>Gait</u>

- Watch the patient walking, first bare-footed and then in shoes, to assess the gait.
- Examine from behind, from in front, and from the side.
- A child should also be made to turn.
- A reluctant child can usually be coaxed to walk holding it's mother's hand.

Skin temperature
Circulation – dorsalis pedis + anterior tibial + posterior tibial artery

- Popletal artery.
- Femoral pulse.

- Abdominal aorta.

-Note any cyanosis of the foot when dependant and blanching on elevation. Suggestive of marked arterial insufficiency.

Tenderness

1- Heel: tenderness round the heel is present in

   a- Sever's disease.

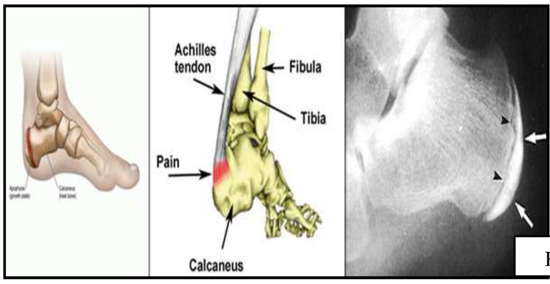


Fig.11.46

   b- Calcaneal exostosis, tendo-calcaneus bursitis.

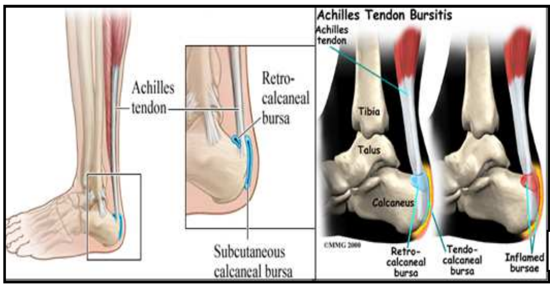


Fig.11.47

   c- Plantar fasciitis.

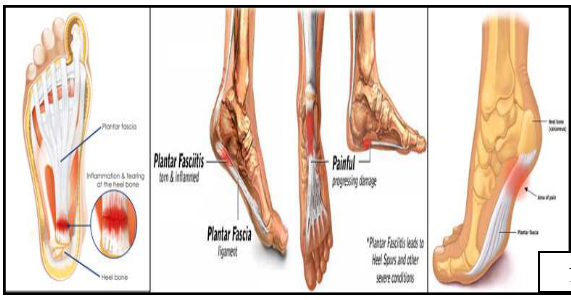


Fig.11.48

   d- Pes cavus.

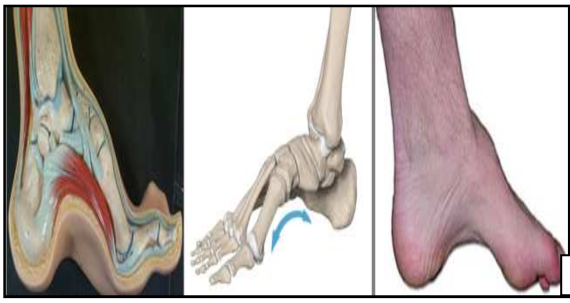


Fig.11.49

2- Forefoot :

   1- Diffuse tenderness under all the metatarsal heads is common in

      a- Anterior metatarsalgia
      b- Pes cavus and pes planus
      c- Gout and rheumatoid arthritis

2- Tenderness under the second metatarsal head and over the metatarso-phalangeal joint is found when the second toe subluxes as a sequel to hallux valgus on rheumatoid arthritis.

3- Puffy locallised swelling on the dorsum of the foot, palpable thickening of the second metatarso-phalangeal joint, pain on plantar-flexion of the toe, and joint tenderness are diagnostic of Freiberg's disease.

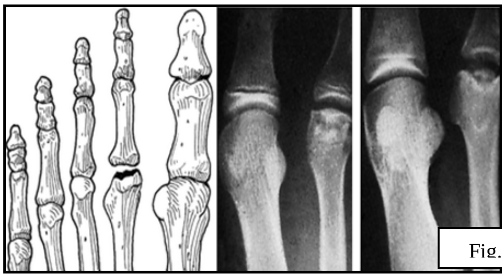


Fig.11.50

4- Tenderness on both plantar and dorsal surface of the second or third metatarsal necks or shafts occurs in March fracture.

Fig.11.51

5- Plantar neuroma

   1- Sharply defined tenderness between the metatarsal heads (most commonly between the third and forth) is found in plantar digital neuroma.

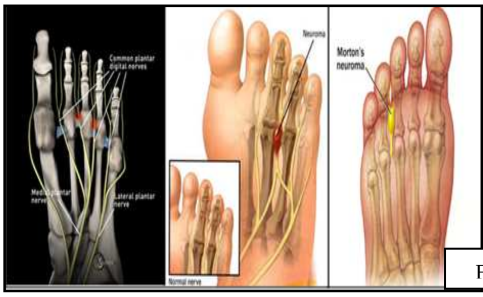


Fig.11.52

   2- Morton's metatonsalgia: occasionally the neuroma may be felt to move by compressing the metatarsal heads with one hand while simultaneously pressing from the sole toward the dorsal surface and back..

   3- Sometimes the patient complains of paraesthesiae in the toes, and sensory impairment should be sought on both sides of the web space involved.

6- Tarsal tunnel syndrome

   1- Tenderness may occur over the posterior tibial nerve in the tarsal tunnel syndrome

   2- Tapping over the posterior tibial nerve may give rise to paraesthesiae in the foot in this condition.

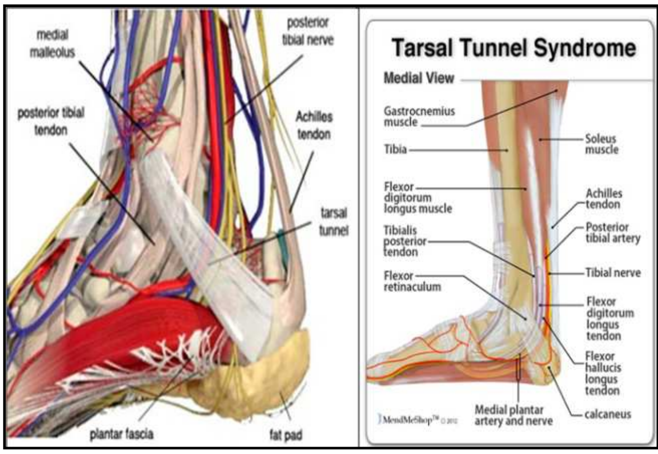


Fig.11.53

3- Test sensation over the whole of the sole of the foot and the toes in the area of supply of the medial and lateral plantar nerves (the two terminal divisions of the posterior tibial nerve) - compare the feet (loss is rather uncommon)

4- In doubtful cases, apply tourniquet to the calf and inflate to just above the systolic blood pressure. – if this brings on the patient’s symptoms in 1-2 min. the diagnosis is confirmed.

7- Great toe

1- In gout, tenderness is often most acute, but is diffusely spread round the whole metatarso-phalangeal joint and often bluish discoloration of the skin round the toe

2- In hallux valgus tenderness is often absent or confined to the bunion
b- in hallux rigidus there is tenderness over the exostoses which form on the metatarsal head and proximal phalanx, often on the dorsal surface as well.

8- In sesamoditis, there is tenderness over the sesamoid bones which are situated under the first metatarsal head.

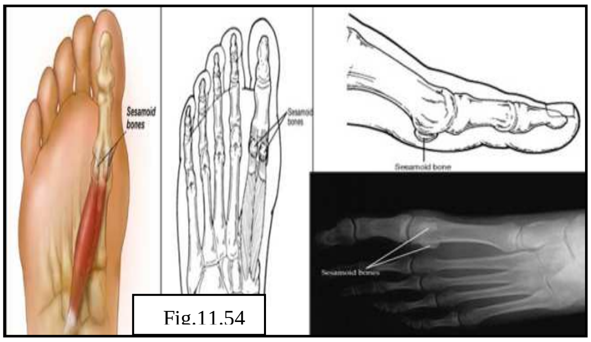


Fig.11.54

-pain is produced if the toe is dorsiflexed while pressure is maintained on the sesamoid bones.

Fig.11.55

9- Great toe nail: in subungual exostosis, pain is produced by squeezing the toe in the vertical plane
- in ingrowing toe nail, pain is produced by side to side pressure.

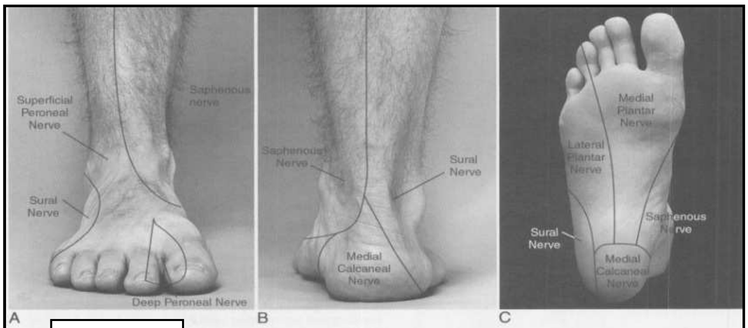


Fig.11.56 A–C, Average distribution of sensory nerves throughout the leg, the ankle, and the foot.

Crepitations

- Crepitations indicating osteo-arthritic changes are constant in the metatarso-phalangeal joint in hallux rigidus.
- Interphalangeal crepitations are a contraindication for metatarso-phalangeal joint fusion.

Movements

1- In assessing foot movements, remember that <u>inversion</u> and <u>eversion</u> (supination and pronation) have contributations from the sub-talar joint, the mid-tarsal joint, and tarso-metatarsal joint
-in the tarso-metatarsal joint, the only significant movement which occurs takes place in the joint between the fourth and the fifth metatarsal and the cuboid.

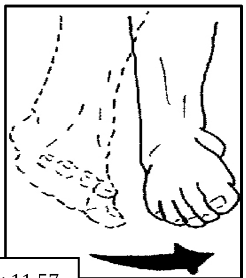


Fig.11.57

2- Inversion
- Ask the patient to turn the sole of the feet towards one another
- The patellae should be vertical
- The resulting angle may be measured

- Normal range = 35˚

3- Eversion
- Ask the patient to turn the feet outwards
- The range of movement may be measured in similar fashion
- Normal range = 20˚

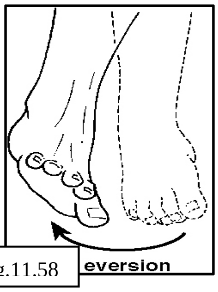


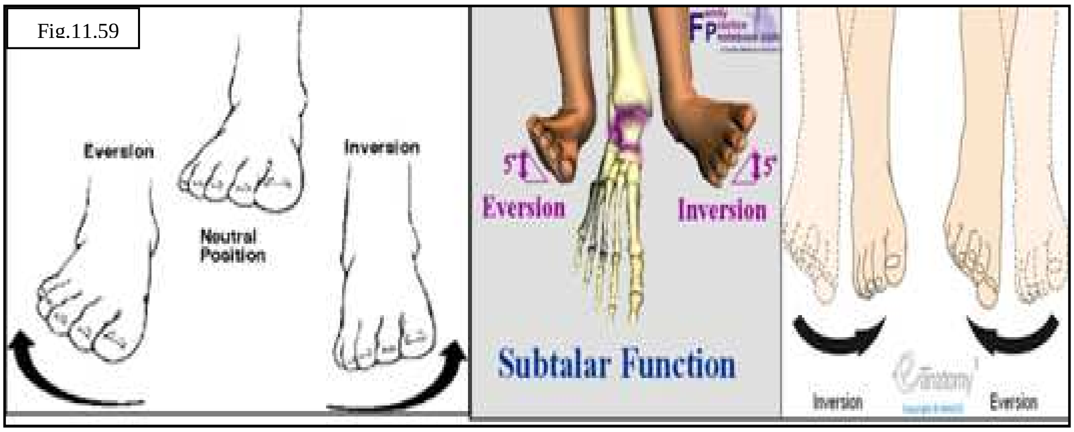
Fig.11.58

4- If inversion and eversion are restricted, fix the heel with one hand and assist the patient with the other to repeat the movements
- No reduction in the range = a stiff sub-talar joint
- Presence of some movement shows the mid-tarsa and tarso-metatasal joint preserve some mobility .

5- Turn the patient face down with the feet over the edge of the examination couch
- Evert the heel and note the presence of movement in the sub-talar joint by the position of the heel
- The normal range of eversion of the heel is about 10˚

6- Repeat forcing the heel into inversion
- The normal range of inversion measurable at the heel is about 20˚
- Loss of movement indicates a stiff sub-talar joint (e.g. old calcaneal fracture, rheumatoid or OH, spastic flat foot).

7- Great toe extension = 65˚
Great toe flexion = 40˚

Fig.11.59


Classification of disorders of the leg, ankle, and foot

1- Disorders of the leg

Injuries

– rupture of the calcaneal tendon

Infections

- Acute osteomyelitis
- Chronis osteomyelitis
- Syphilitic infection

Tumours

- Benign tumours of bone
- Malignant tumours of bone

Circulatory disorder

- Intermittent claudication.

2- Disorders of the ankle

Arthritis

- Pyogenic
- Rheumatoid
- Osteoarthritis
- Gouty
- Heamophilic
- Neuropathic

Post-traumatic mechanical derangements

- Recurrent subluxation

3- Disorders of the foot

Deformities

- Congenital club foot (talipes equino-varus)
- Talipes calcaneo-valgus
- Accessory bones in the foot
- Pes cavus
- Pes planus (flat foot)

Postural disorders

- Foot strain

Arthritis

- O.A of the tarsal joints
- Other forms of tarsal arthritis

Osteochondritis

- Osteochondritis of the navicular bone.(Köhler's disease)

Miscellaneous

- Painful heel

- Pain in the forefoot
- Plantar wart
- Callosities
- Ganglion

4- Disorder of the toes

Deformities
- Hallux valgus
- Hammer toe
- Under-riding toe

Arthritis
- Osteoarthritis
- Gouty arthritis

Osteochondritis
- Osteochondritis of a metatarsal head (Freiberg's disease).

Miscellaneous
- Ingrowing toe nail
- Subungual exostosis
- Onychogryposis

Notes on applied anatomy

The ankle and foot in action as an integrated unit, and together provide stable support, proprioception, balance and mobility

a- The ankle.
The ankle fits together like a tendon and mortise, the tibial and fibular parts of the mortise are bound together by the inferior tibiofibular ligament, and stability is augmented by the collateral ligaments.
- The medial ligament fans out from the tibial malleolus to the talus, the superficial fibers forming the deltoid ligament
- The lateral ligament has three thickened bands ; the anterior and posterior talofibular ligament and, between them, the calcaneofibular ligament.
- Tears of these ligaments may causing tilting of the talus in its mortise.
- Forced abduction or adduction may disrupt the mortise al together by : - forcing the tibia and fibula apart (diastasis of the tibiofibular joint)
  -Tearing the collateral ligament or
  -Fracturing the malleoli.

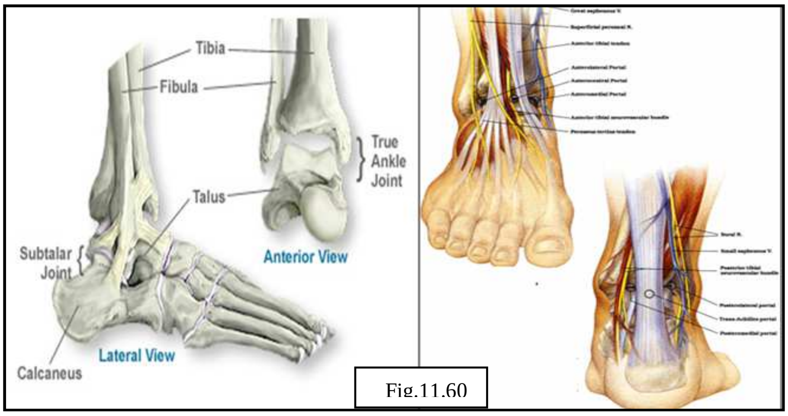


Fig.11.60

b- The foot.

The foot print gives some idea of the arched structure of the foot

- This drives from the tripodial bony framework between the calcaneum posteriorly, and the first and fifth metatarsal heads
- The medial arch is high, with the navicular as it's key stone.

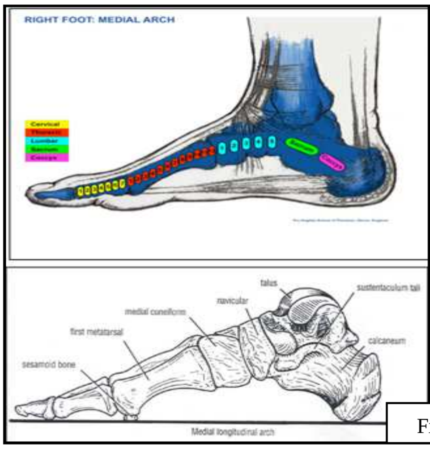


Fig.11.61

- The lateral arch is flatter.
- The anterior arch, formed by the metatarsal bones, thrusts maximally upon the first and fifth metatarsal heads and flattens out (spreading the foot) during weight-bearing; it can be pulled up by contraction of the intrinsic muscles, which flex the metatarso-phalangeal joints
- The human foot has become greatly specialized for the performance of two divergent functions
  1- In standing it must provide a stable support for the body weight – a passive function – balance.
  2- In walking it must, in addition to supporting the body weight, provide a resilient spring or lever by which the body can be propelled forwards – its active function – propulsion

Movements

- The ankle allows movement in the sagital plane only – plantarflexion and dorsiflexion

- Adduction and abduction (turning the toes towards or away from the midline) are produced by rotation of the entire leg below the knee
- If either is forced at the ankle, the mortise fractures.
- Pronation and supination occur at the intertarsal and tarsometataarsal joint; the foot rotates about an axis running through the second metatarsal, the sole turning laterally (pronation) or medially (supination)
- The combination of plantarflexion, adduction, and supination is called Inversion.
- The opposite movement of dorsiflexion, abduction and pronation ie Eversion

Foot position and deformities
- A downward-pointing foot is said to be in equinus
- The opposite is calcaneus
- If only the forefoot points downwards the term “ plantaris” is used
- Supination with adduction produce a Varus deformity
- Pronation with abduction causes pes valgus
- In unusually high arch is called pes cavus

Ankle and Foot

WHERE DOES IT HURT; WHERE IS IT TENDER?
Anterior ankle joint line – impingement from osteophytes in OA
Anterolateral angle of ankle joint – lateral gutter impingement in post-traumatic ankle with soft tissue problems
Bony tip/lateral malleolus – ankle fracture (Ottawa guidelines)
Posterior/inferior to lateral malleolus – peroneal tenosynovitis or tear
Posterior to medial malleolus/line of tibialis posterior – tibialis posterior tendinitis or tear, and in plano-valgus collapse of hindfoot
Base of fifth metatarsal – fracture/insertional problem with peroneus brevis
Achilles tendon – Achilles tendinitis/paratendinitis
Achilles insertion – insertional tendinitis
Retrocalcaneal bursa – bursitis
Plantar fascia – plantar fasciitis
Medial to first MTP joint – bunion
Dorsal to first MTP joint – OA, hallux limitus/rigidus
Beneath first MTP joint – sesamoiditis
Beneath metatarsal heads – 'metatarsalgia'
In third interspace – Morton's neuroma

Imaging:

There are practical problems with imaging in children, and babies in particular because: (1) babies tend not to keep still during examination; (2) their bones are not completely ossified and their shape and position may be hard to define.

X-rays: In the adult, the standard views of the ankle are anteroposterior (AP), mortise (an AP view with the ankle internally rotated 15–20 degrees) and lateral. Although the subtalar joint can be seen in a lateral view of the foot, medial and lateral oblique projections allow better assessment of the joint. These views are often used to check articular congruity after treatment of calcaneal fractures. The calcaneum itself is usually x-rayed in axial and lateral views, but a weightbearing view is helpful in defining its relationship to the talus and tibia. The foot, toes and intertarsal joints are well displayed in standing anteroposterior and medial oblique views, but occasionally a true lateral view is needed.

Stress x-rays: These complement the clinical tests for ankle stability. The patient should be completely relaxed; if the ankle is too painful, stress x-rays can be performed under regional or general anaesthesia. Both ankles should be examined, for comparison.

(a) (b) (c) (d)

Fig.11.62 (a) AP view of the ankle in a young woman who complained that after twisting her right ankle it kept giving way in high-heeled shoes. The x-ray looks normal; the articular cartilage width (the 'joint space') is the same at all aspects of the joint. The inversion stress view (b) shows that the talus tilts excessively; always x-ray both ankles for comparison and in this case the left ankle (c) does the same. She has generalized joint hypermobility, not a torn lateral ligament. (d) X-rays of the feet should be taken with the feet flat on the ground.

Painful feet:

"My feet are killing me!" This complaint is common but the cause is often elusive. Pain may be due to: (1) mechanical pressure (which is more likely if the foot is deformed or the patient obese); (2) joint inflammation or stiffness; (3) a localized bone lesion; (4) peripheral ischaemia; (5) muscular strain – usually secondary to some other abnormality. Remember, too, that local disorders may be part of a generalized disease (e.g. diabetes or rheumatoid arthritis), so examination of the entire patient may be indicated.

Specific foot disorders that cause pain are considered later.

Note:

Hind-foot= consist of→ Talus + Calcaneus.

Calcaneus= Os Calcis.
Talus= astragalus.

POSTERIOR HEEL PAIN:

Two common causes of heel pain are traction 'apophysitis' and calcaneal bursitis:
Traction 'apophysitis' (Sever's disease): This condition usually occurs in boys aged about 10 years. It is not a 'disease' but a mild traction injury. Pain and tenderness are localized to the tendo Achillis insertion. The x-ray report usually refers to increased density and fragmentation of the apophysis, but often the painless heel looks similar. The heel of the shoe should be raised a little and strenuous activities restricted for a few weeks.
Calcaneal bursitis: Older girls and young women often complain of painful bumps on the backs of their heels. The posterolateral portion of the calcaneum is prominent and shoe friction causes retrocalcaneal bursitis. Symptoms are worse in cold weather and when wearing high-heeled shoes (hence the use of colloquial labels such as 'winter heels' and 'pumpbumps').
- *Treatment:* should be conservative – attention to footwear (open-back shoes are best) and padding of the heel. Operative treatment – removal of the bump or dorsal wedge osteotomy of the calcaneum – is feasible but the results are unpredictable; despite the reduction in the size of the bumps, patients often continue to experience discomfort, potentially added to by an operation scar.

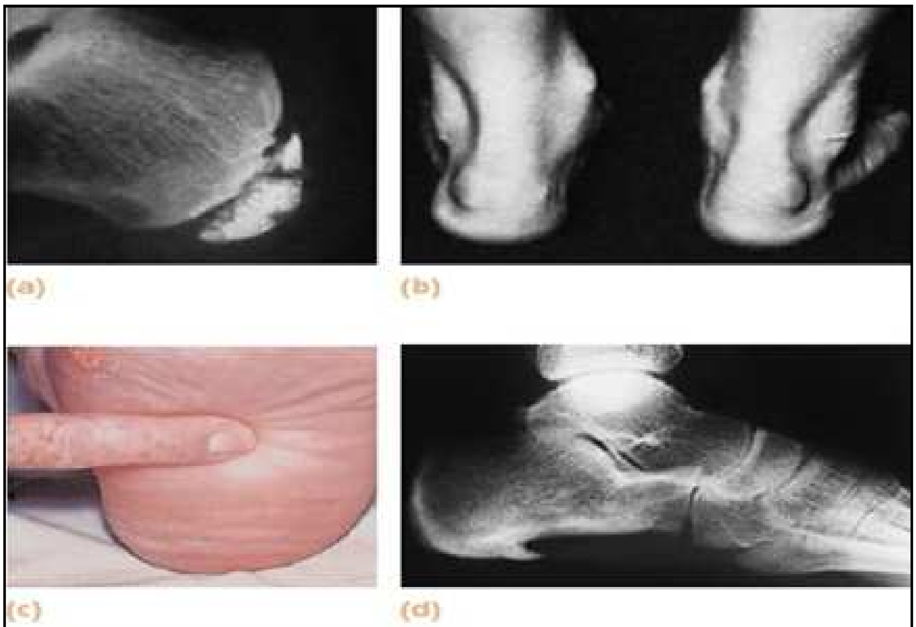


Fig.11.63 Painful heel (a) Sever's disease – the apophysis is dense and fragmented. (b) Bilateral 'heel bumps'. (c) The usual site of tenderness in plantar fasciitis. (d) X-ray in patients with plantar fasciitis often shows what looks like a spur on the undersurface of the calcaneum. In reality this is a two-dimensional view of a small ridge corresponding to the attachment of the plantar fascia. It is doubtful whether the 'spur' is responsible for the pain and local tenderness.

INFERIOR HEEL PAIN:

Calcaneal bone lesions: Any bone disorder in the calcaneum can present as heel pain: a stress fracture, osteomyelitis, osteoid osteoma, cyst-like lesions and Paget's disease are the most likely. X-rays usually provide the diagnosis.

PLANTAR FASCIITIS:

This is an annoying and painful condition that limits function. There is pain and tenderness in the sole of the foot, mostly under the heel, with standing or walking. The condition usually comes on gradually, without any clear incident or injury but sometimes there is a history of sudden increase in sporting activity, or a change of footwear, sports shoes or running surface. There may be an associated tightness of the Achilles tendon. The pain is often worse when first getting up in the morning, with typical hobbling downstairs, or when first getting up from a period of sitting – the typical start-up pain and stiffness. The pain can at times be very sharp, or it may change to a persistent background ache as the patient walks about. The condition can take 18–36 months or longer to resolve, but is generally self-limiting, given time.

Clinical features: There is localized tenderness, usually at the medial aspect beneath the heel and sometimes in the midfoot. This is essentially a clinical diagnosis. If there are features suggesting an inflammatory disease (seronegative arthropathy) then blood tests may be indicated. An ultrasound scan shows the thickening and sometimes the Doppler test shows increased local blood flow and neovascularization, but this investigation is not indicated in every case.

A plain lateral x-ray: can help to exclude a stress fracture, and will often show what looks like a bony spur on the undersurface of the calcaneum. The 'spur' is, in fact, a bony ridge that looks sharp and localized in the two-dimensional x-ray image; it is an associated, not a causative, feature in plantar fasciitis. Patients, and sometimes doctors, can become fixated on the idea of a spur of bone causing the symptoms by digging into the plantar fascia, and cannot conceive of how the condition could possibly resolve whilst the spur remains – but it can and does get better.

Note:

Mid-foot= consist of five bones, packed closely together:-

(1)**Navicular** bone: which is medial & superior.

(2)**Cuboid** bone, which is lateral & inferior.

(3)three **Cuneiform** bones (**medial**, **intermediate** & **lateral** once): which lie in a row, distal to the Navicular bone.

PAIN OVER THE MIDFOOT:

In children, pain in the midtarsal region is rare: one cause is *Kohler's disease* (osteochondritis of the navicular). The bony nucleus of the navicular becomes dense and fragmented. The child, under the age of 5, has a painful limp and a tender warm thickening over the navicular. Usually no treatment is needed as the condition resolves spontaneously. If symptoms are severe, a short period in a below-knee plaster helps.
A comparable condition occasionally affects middle- aged women (*Brailsford's disease*); the navicular becomes dense, then altered in shape, and later the midtarsal joint may degenerate.

In adults, especially if the arch is high, a ridge of bone sometimes develops on the adjacent dorsal surfaces of the medial cuneiform and the first metatarsal (the '*overbone*'). A lump can be seen, which feels bony and may become bigger and tender if the shoe presses on it. If shoe adjustment fails to provide relief the lump may be bevelled off.

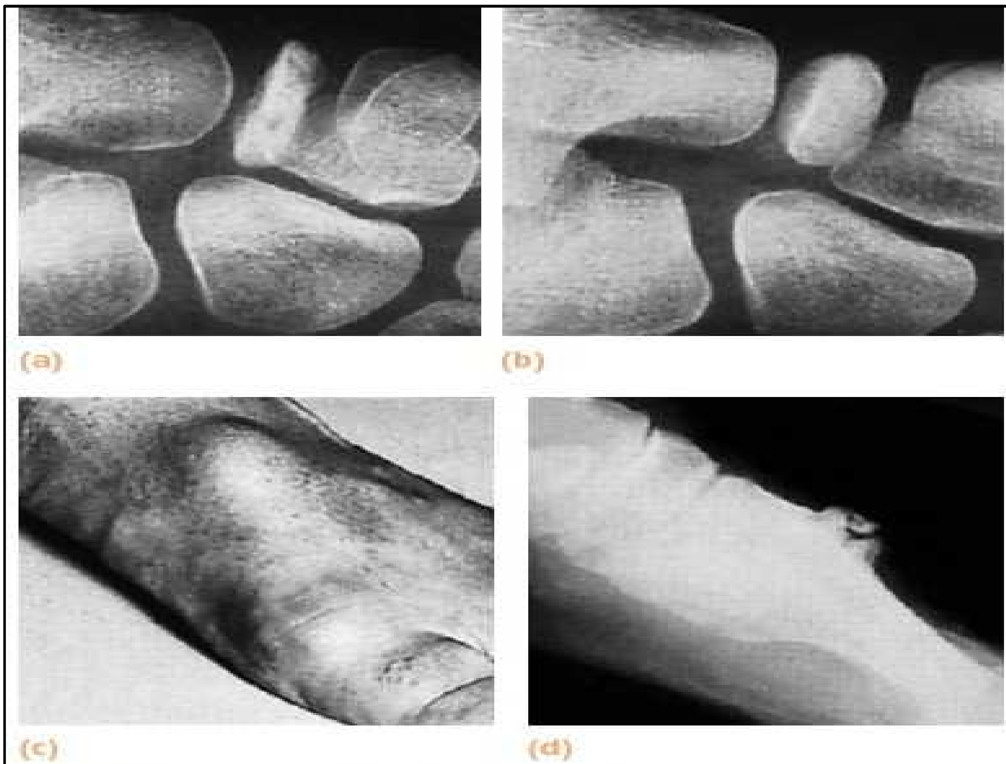


Fig.11.64 Pain over the midfoot (a) Köhler's disease compared with (b) the normal foot. (c,d) The bump on the dorsum of the foot due to OA of the first cuneiform-metatarsal joint.

Note:

Fore-foot= consist of the five **metatarsals** bones & **toes** (& their **phalanx**).

GENERALIZED PAIN IN THE FOREFOOT:

Metatarsalgia: Generalized ache in the forefoot is a common expression of foot strain, which may be due to a variety of conditions that give rise to faulty weightm distribution (e.g. flattening of the metatarsal arch, or undue shortening of the first metatarsal), or merely the result of prolonged or unaccustomed walking, marching, climbing or standing. These conditions have this in common: they give rise to a mismatch between the loads applied to the foot, the structure on which those loads are acting, and the muscular effort required to maintain the structure so that it can support those loads. Aching is felt across the forefoot and the anterior metatarsal arch may have flattened out. There may even be callosities under the metatarsal heads.

Pain in metatarsophalangeal joints: Inflammatory arthritis (e.g. rheumatoid disease) may start in the foot with synovitis of the MTP joints. Pain in these cases is associated with swelling and tenderness of the forefoot joints and the features are almost always bilateral and symmetrical.

Fig.11.65

Pain in the forefoot (a) Long-standing deformities such as dropped anterior arches, hallux valgus, hammer-toe, curly toes and overlapping toes (all of which are present in this patient) can cause metatarsalgia. Localized pain and tenderness suggest a more specific cause. (b,c) Stages in the development of Freiberg's disease. (d) Periosteal new-bone formation along the shaft of the second metatarsal, the classic sign of a healing stress fracture.

LOCALIZED PAIN IN THE FOREFOOT:

Whereas metatarsalgia involves the entire forefoot, localized pain and tenderness is related to a specific anatomical site in the forefoot and could be due to a variety of bone or soft tissue disorders: ‘sesamoiditis’, osteochondritis of a metatarsal head (Freiberg’s disease), a metatarsal stress fracture or digital nerve entrapment (Morton’s disease).

(a) (b) (c) (d)

Pain in the forefoot (a) Long-standing deformities such as dropped anterior arches, hallux valgus, hammer-toe, curly toes and overlapping toes (all of which are present in this patient) can cause metatarsalgia. Localized pain and tenderness suggest a more specific cause. (b,c) Stages in the development of Freiberg's disease. (d) Periosteal new-bone formation along the shaft of the second metatarsal, the classic sign of a healing stress fracture.

Sesamoiditis:

Pain and tenderness directly under the first metatarsal head, typically aggravated by walking or passive dorsiflexion of the great toe, may be due to sesamoiditis. This term is a misnomer: symptoms usually arise from irritation or inflammation of the peritendinous tissues around the sesamoids – more often the medial (tibial) sesamoid, which is subjected to most stress during weightbearing on the ball of the foot.

Acute sesamoiditis: may be initiated by direct trauma (e.g. jumping from a height) or unaccustomed stress (e.g. in new athletes and dancers).

Chronic sesamoid pain and tenderness: should signal the possibility of sesamoid displacement, local infection (particularly in a diabetic patient) or avascular necrosis.

Sesamoid chondromalacia: is a term coined by Apley (1966) to explain changes such as fragmentation and cartilage fibrillation of the medial sesamoid. X-rays in these cases may show a bipartite or multipartite medial sesamoid, which is often mistaken for a fracture.

Freiberg's disease (osteochondritis; osteochondrosis):

Osteochondritis (or osteochondrosis) of a metatarsal head is probably a type of traumatic osteonecrosis of the subarticular bone in a bulbous epiphysis (akin to osteochondritis dissecans of the knee). It usually affects the second metatarsal head (rarely the third) in young adults, mostly women.

The patient complains of pain at the MTP joint. A bony lump (the enlarged head) is palpable and tender and the MTP joint is irritable. X-rays show the head to be flattened and wide, the neck thick and the joint space apparently increased.

If discomfort is marked, a walking plaster or moulded sandal will help to reduce pressure on the metatarsal head. If pain and stiffness persist, operative synovectomy, debridement and trimming of the metatarsal head should be considered. Pain relief is usually good and the range of dorsiflexion is improved.

Stress fracture:

Stress fracture, usually of the second or third metatarsal, occurs in young adults after unaccustomed activity or in women with postmenopausal osteoporosis. The dorsum of the foot may be slightly oedematous and the affected shaft feels thick and tender. The x-ray appearance is at first normal, but later shows fusiform callus around a fine transverse fracture. Long before x-ray signs appear, a radioisotope scan will show increased activity.

Interdigital nerve compression (Morton's metatarsalgia):

Morton's metatarsalgia is a common problem, with neuralgia affecting a single distal metatarsal interspace, usually the third (affecting the third and fourth toes), sometimes the second (affecting the second and third toes), rarely others. The patient typically complains of pain on walking, with the sensation of walking on a pebble in the shoe, or of the sock being rucked-up under the ball of the foot. The pain is worse in tight footwear and often has to be relieved by removing the footwear and massaging the foot. Activities that load the forefoot (running, jumping, dancing) exacerbate the condition, which often consists of severe forefoot pain and then a reluctance to weightbear. In Morton's metatarsalgia the pain is typically reproduced by laterally compressing the forefoot whilst also compressing the affected interspace – this produces the pathognomic Mulder's click as the 'neuroma' displaces between the metatarsal heads. This is essentially an entrapment or compression syndrome affecting one of the digital nerves, but secondary thickening of the nerve creates the impression of a 'neuroma'. The lesion, and an associated bursa, occupy a restricted space between the distal metatarsals, and are pinched, especially if footwear also laterally compresses the available space.

TARSAL TUNNEL SYNDROME:

Pain and sensory disturbance in the medial part of the forefoot, unrelated to weightbearing, may be due to compression of the posterior tibial nerve behind and below the medial malleolus. Sometimes this is due to a space-occupying lesion, e.g. a ganglion, haemangioma or varicosity. The pain is often worse at night and the patient may seek relief by walking around or stamping the foot. Paraesthesia and numbness may follow the characteristic sensory distribution, but these symptoms are not as well defined as in other entrapment syndromes. The diagnosis is difficult to establish but nerve conduction studies may show slowing of motor or sensory conduction.

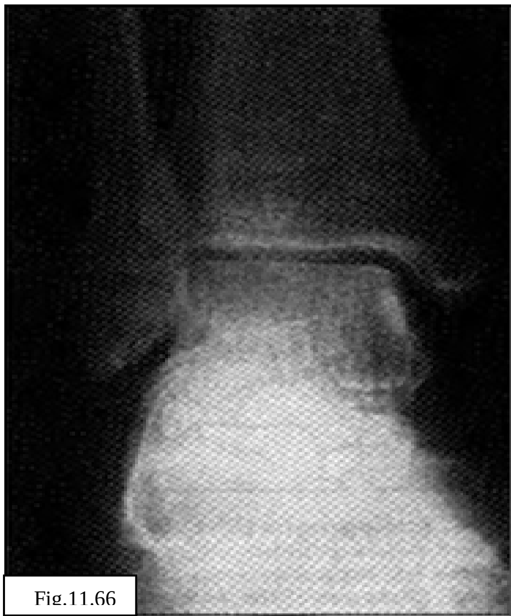


Fig.11.66

Radiographs (1): Normal anteroposterior radiograph of the ankle.

Fig.11.67

Radiographs (2): Normal lateral radiograph of the ankle.

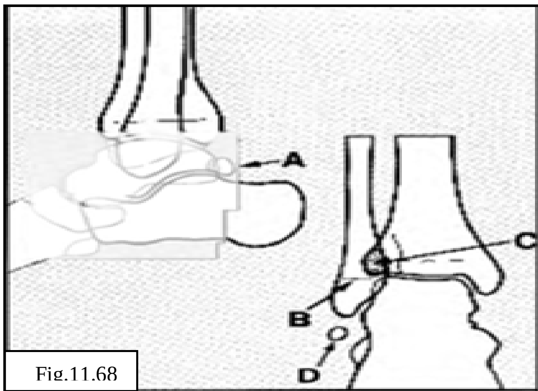


Fig.11.68

Radiographs (3): In the standard AP and lateral projections do not mistake (A) the common os trigonum accessory bone and (B) the epiphyseal line of the fibula for fractures. The amount of tibiofibular overlap (C) is dependent on positioning and any diastasis. The os fibulare (D) is thought to represent an avulsion of the anterior talofibular ligament, and may be associated with instability.

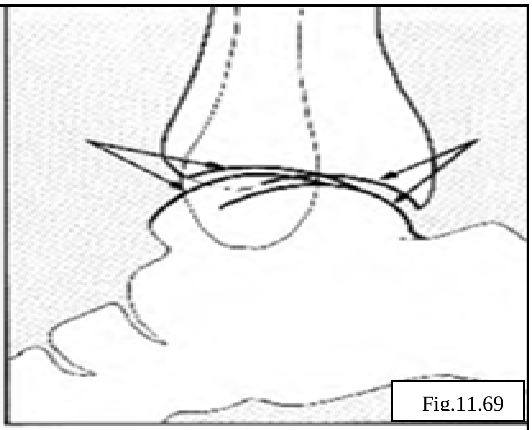


Fig.11.69

Radiographs (4): The articular margins of tibia and talus should appear as two congruent circular arcs. If there is some difficulty in positioning that cannot be improved upon, four arcs will be seen. Two pairs should be congruent, as shown. If not, there is a subluxation.

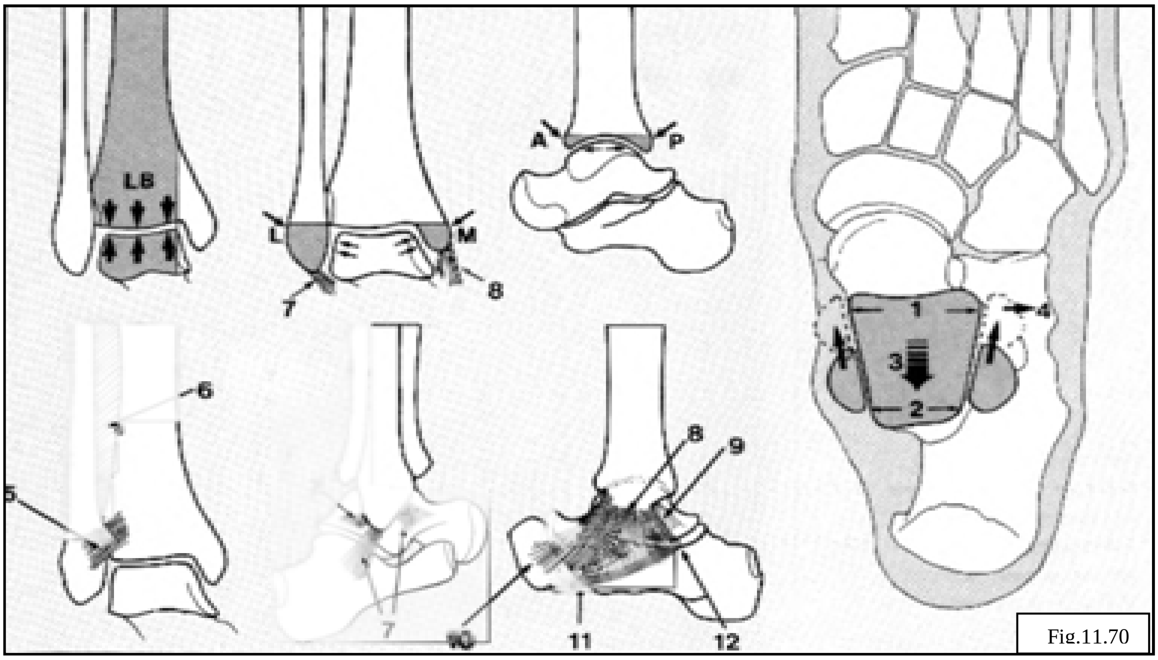
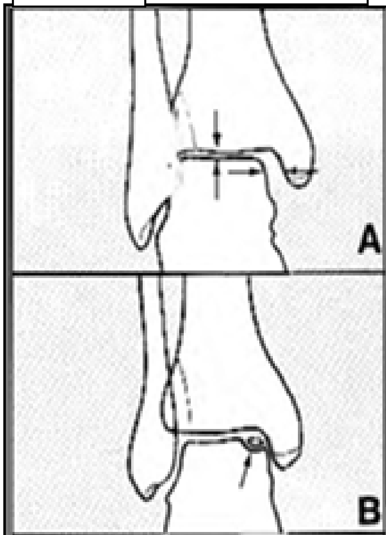


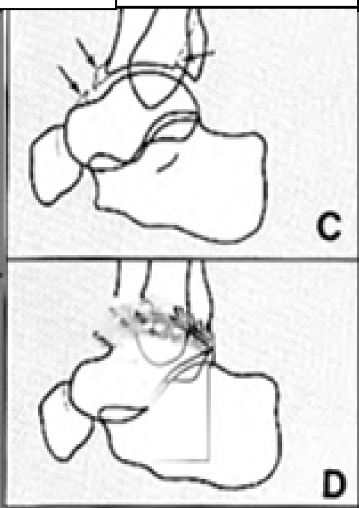
Fig.11.70

Fig.11.71



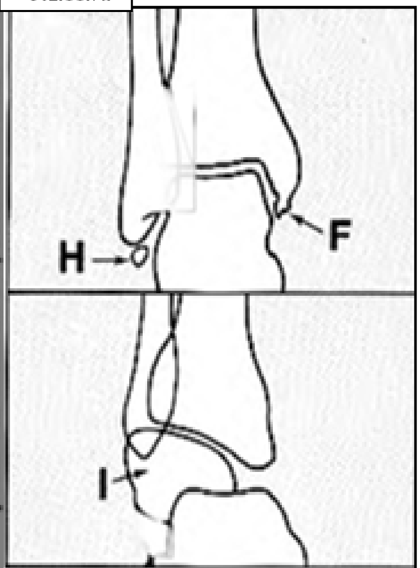
Rodiographs (5): Note any widening of the gap (A) between talus and medial malleolus: this is suggestive of diastasis (compare its size with the one between the upper surface of talus and the tibia: they should normally be equal). (B) Note the presence of any defects in the articular surface of the talus, suggestive of osteochondritis tali. CT and MRI scans may help in the doubtful case.

Fig.11.72



Radiographs (6): (C) Note any irregularity in the joint surfaces that may suggest previous fracture, e.g. of the posterior malleolus; note any anterior exostoses of the tibia (and/or the talus), which are a feature of footballer's ankle. (D) Examine the articular margins for exostoses, joint space narrowing and cystic change, which are common features of osteoarthritis. If these are present, look for a possible cause (such as osteochondritis dissecans), as primary osteoarthritis of the ankle is uncommon.

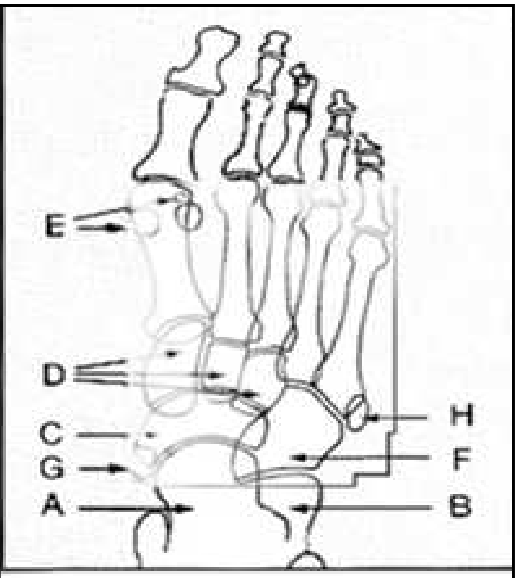
Fig.11.73



Radiographs (7): Look at the malleoli, where deformity (F) or rounded shadows (H) suggest previous avulsion injuries. Distortion of the talus occurs in association with talipes deformities (I) and after injuries which have resulted in avascular necrosis, and where there may be increases in bone density.

Fig.11.74

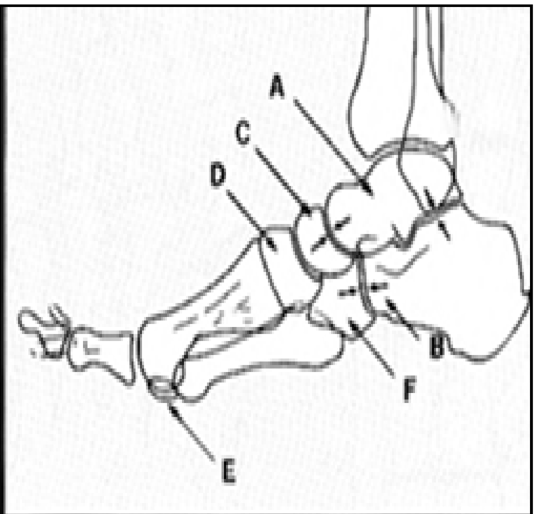
. **Radiographs (1):** Normal anteroposterior radiograph of the foot.



Radiographs (2): An AP view is routine, along with either a lateral or an oblique. Note (A) talus; (B) calcaneus; (C) navicular; (D) cuneiforms; (E) sesamoids (often bi- or tripartite); (F) cuboid. Inconstant accessory bones may be mistaken for fracture or loose bodies, e.g. (G) os tibiale externum; (H) os Vesalianum.

Fig.11.75

Radiographs (6): Normal lateral radiograph of the foot.



Radiographs (7): In the lateral radiograph it is often difficult to trace the outline of individual metatarsals owing to superimposition, although the first and fifth are usually quite clear. (A) talus, (B) calcaneus, (C) navicular, (D) medial cuneiform, (E) sesamoid, (F) cuboid. Note the talonavicular and calcaneocuboid joints.

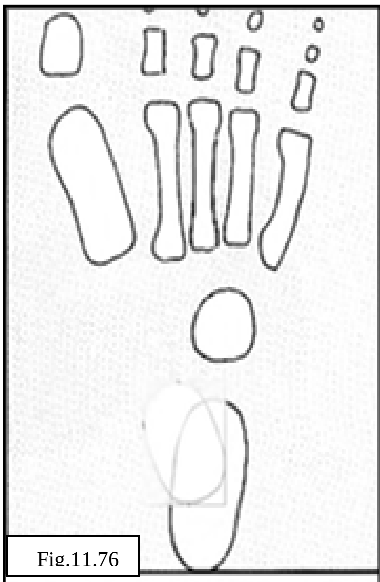


Fig.11.76

Radiographs: Anteroposterior view (1): Interpretation is difficult owing to the incompleteness of ossification. Centres for the talus, calcaneus, metatarsals, phalanges, and often the cuboid are present at birth. Begin by drawing a line through the long axis of the talus.

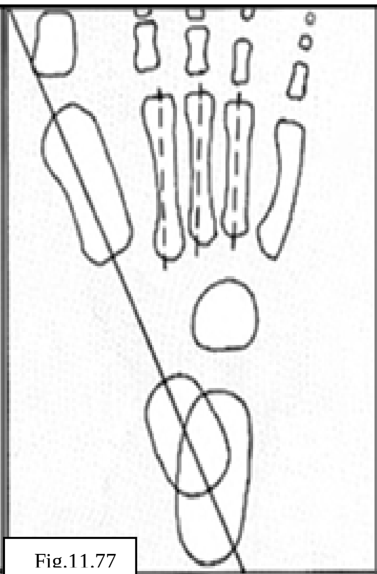


Fig.11.77

Radiographs: Anteroposterior view (2): This line normally passes through the first metatarsal, or lies along its medial edge. Note also that the axes of the middle three metatarsals are roughly parallel. Now draw a second line through the long axis of the calcaneus.

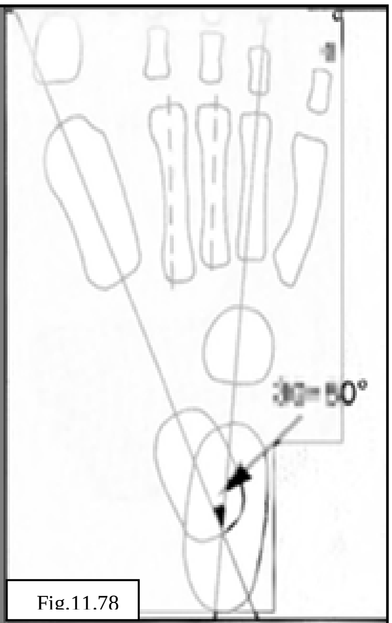


Fig.11.78

Radiographs: anteroposterior view (3): Note (A) the axial line of the calcaneus passes through or close to the fourth metatarsal. (B) The axes of the talus and calcaneus subtend an angle of 30–50°.

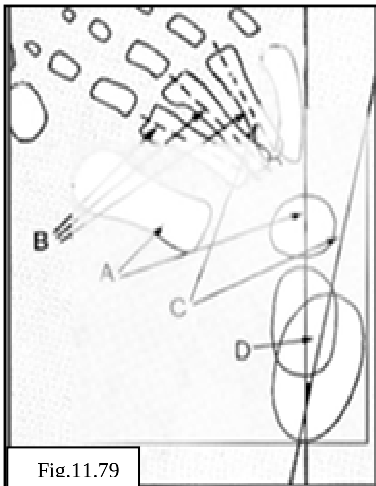


Fig.11.79

Radiographs: Anteroposterior view (4): In club foot, the previously described relations are altered owing to forefoot adduction. Note (A) the talar axis does not cut the first metatarsal; (B) the middle three metatarsal axes are not parallel; (C) the calcaneal axis does not strike the fourth metatarsal; (D) the angle between the talus and calcaneus is reduced.

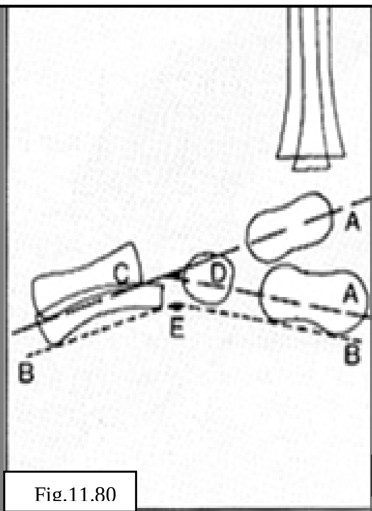


Fig.11.80

Radiographs: Lateral (1): Draw (A) axes through talus and calcaneus, and (B) tangents to the calcaneus and fifth metatarsal. Note that in the normal foot at birth that the talar axis passes below the first metatarsal (C); the interaxial angle (D) is 25–50°; the angle between the tangents (E) is 150–175°.

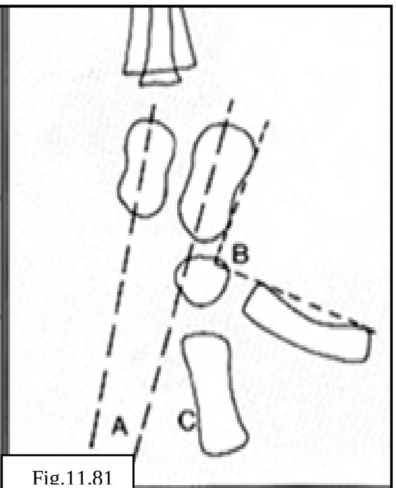


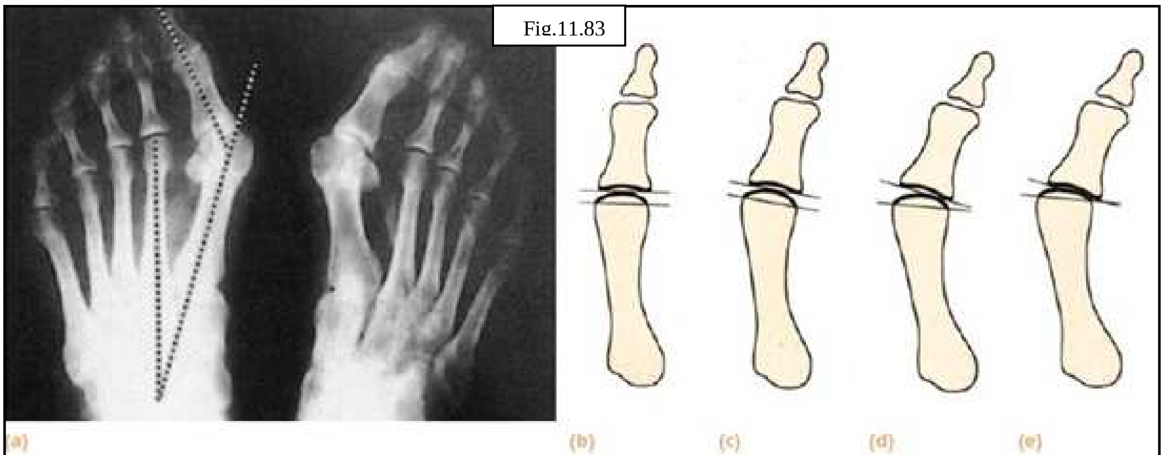
Fig.11.81

Radiographs: Lateral (2): In club foot, note (A) the talar and calcaneal axes are nearly parallel; (B) the angle of the tangents is less obtuse; (C) the talar axis does not pass below the first metatarsal. Geometric analysis of the type discussed on this page may be of help in the doubtful case and in assessing progress, and MRI scans are of particular value in determining talonavicular alignment.

Fig.11.82

Talipes equinovarus – x-rays The left foot is abnormal. In the anteroposterior view (a) the talocalcaneal angle is 5 degrees, compared to 42 degrees on the right. In the lateral views, the left talocalcaneal angle is 10 degrees in plantarflexion (b) and 15 degrees in dorsiflexion (c). In the normal foot the angle is unchanged at 44 degrees, whatever the position of the foot (d,e).

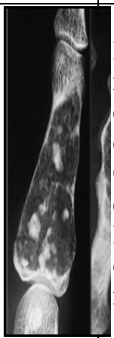
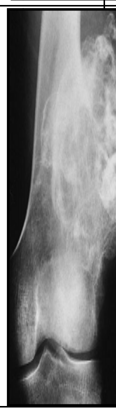
Fig.11.83



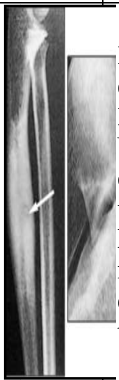
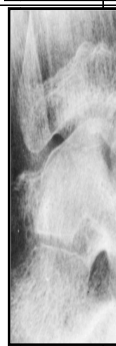
X-rays (a) The intermetatarsal angle (between the first and second metatarsals) as well as the metatarsophalangeal angle of the hallux are recorded. Piggott (1960) defined three types of hallux valgus, based on the position and tilt of the first MTP articular surfaces: In *normal feet* (b) the articular surfaces are parallel and centred upon each other. In *congruent hallux valgus* (c) the lines across the articular surfaces are still parallel and the joint is centred, but the articular surfaces are set more obliquely to the long axes of their respective bones. In (d) the *deviated type of hallux valgus*, the lines are not parallel and the articular surfaces are not congruent. In *the subluxated type* (e) the surfaces are neither parallel nor centred.

Chapter 12
Bone Tumour

Benign Bone Lesions

Tumour	Age	Sex	Type of bone	Where is the lesion in the bone	Bone reaction	Calcification	Predominant cells	X-Ray	Notes
Chondroma. Enchondroma , Eccochondroma.	10-50 y.		Phalanges of the hand and feet. Rare long bones & ribs or pelvis.	Diaphyseal. Rare Metaphyseal	✗	→	It is a cartilaginous hamartoma. (from embryonic cartilage).		If multiple= dyschondroblais= Oller's disease. Malignant changes reported.
Osteochondroma. Cartilage-capped exostosis.	During a growth period.		Enchondral bones. (long Bones).	Metaphyseal. (around the knee)	✗	✗	Normal bone & cartilage cells.		Malignant changes to chondrosarcoma=1%

Benign Bone Lesions

Tumour	Age	Sex	Type of bone	Where is the lesion in the bone	Bone reaction	Calcification	Predominant cells	X-Ray	Notes
Osteoid Osteoma	Under 30y. 10-30y	Male more	Any bone except the skull	Metaphyseal Rarely diaphyseal.	→	✗	Fibroblast Osteoblast		Intraoperative Localization by injection of technetium labeled methylene diphosphonate.
Osteoblastoma. Giant osteoid osteoma, Osteogenic fibroma.	Less 20y.	M:F 2:1	Posterior element of the spine. Long & short tubular bone.	Metaphyseal & diaphyseal.	→	→ Well demarcated osteolytic lesion contain speks of calcification	Osteoblast Giant cells of osteoclast & macrophages, not like Giant cell tumour.		Malignant changes reported.

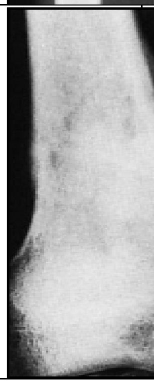
Benign Bone Lesions

Tumour	***Age***	***Sex***	***Type of bone***	***Where is the lesion in the bone***	***Bone reaction***	***Calcification***	***Predominant cells***	***X- Ray***	***Notes***
Chondroblastoma.	10-20y Before epiphyseal closure.	Male more	Ends of long bones. Around knee, hip, upper humerous.	Epiphysis or epiphyseo-metaphyseal junction.	✗	→	Young chondroblast.		Eccentric location malignant changes. Rarely cause #.
Chondro-myxoid fibroma.	10-30 y.	--	Tubular bones (short or long). Around the knee.	Metaphysis.	✗	✗	Myxomatous cells & fibrous tissues + Chondroid tissue and giant cells.		Eccentric cyst like lesion.

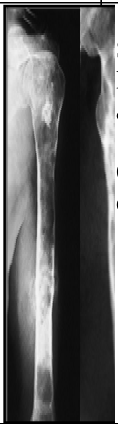
Benign Bone Lesions

Tumour	Age	Sex	Type of bone	Where is the lesion in the bone	Bone reaction	Calcification	Predominant cells	X- Ray	Notes
Aneurismal bone cyst.	10-30 y.	Male more	Long bones. Vertebra (body+arch).	Metaphysis.			Vascular lares Fibrous tissue Giant cells Osteoid trabeculae.		Eccentric, expanded cystic and ballooned bone.
Unicameral bone cyst.	Any age. Before 20 rarely after 20	M: F 2:1	Tubular bone. Upper humerous. Upper femour. Upper tibia. Calceneum.	Metaphysis close to the epiphysis.			Cyst with fibrous lining, which may contain giant cells & chronic inflammatory cells.		Expansion of the shaft is usually not wider than the adjacent metaphysis.

Malignant Bone Lesions

Tumour	*Age*	*Sex*	*Type of bone*	*Where is the lesion in the bone*	*Bone reaction*	*Calcification*	*Predominant cells*	*X- Ray*	*Notes*
Giant cell tumour. osteoclastoma	20-40 y.	Female more	Long bones. Vertebrae + sacrum. Around knee. Distal radius.	Eccentric close to the articular surface.	✗	✗	Giant cells.		Effect the epiphysis of long bones when the growth is most rapid.
Osteogenic sarcoma.	10-20y. (60-70y) secondary Paget's.	Male more	Long bones. Around knee, upper humerus.	Metaphysis Eccentric.	→	✗	Osteoid tissue. Osteoblast. Chondroblast. Fibroblast.		Physis act as a barrier & latter on the articular surface

Malignant Bone Lesions

Tumour	***Age***	***Sex***	***Type of bone***	***Where is the lesion in the bone***	***Bone reaction***	***Calcification***	***Predominant cells***	***X-Ray***	***Notes***
Chondrosarcoma. Central Prepheral.	Above 30 40-70 y.		Proximal femur. Proximal humerus. Innominate bone, ribs, scapula.	Diaphysis. Metaphysis.	✗	→	Double nuclei chondrocytes.		Secondary to Enchondroma or Osteochondroma.
Fibrosarcoma Central Prepheral.	Above 30	Male more	Long and flat bones.	Metaphysis Diaphysis.	✗	✗	Fibroblast. Spindle cells. Produce collagen but not osteoid. Tumour giant cells.		Can arise from normal bone or from irradiation of Giant cells or Paget's disease.

Malignant Bone Lesions

Tumour	Age	Sex	Type of bone	Where is the lesion in the bone	Bone reaction	Calcification	Predominant cells	X- Ray	Notes
Ewing's tumour Undifferentiated round cell sarcoma. Endothelial myeloma.	5-30 y. Usually children & adolescents.		Long bones. Others bones rarely.	Diaphysis. Rarely Metaphysis.	→	✗	Endothelial marrow cells. Round cells.		General future Glycogen + From endothelial cells of reticluendotheal tissue of supportive marrow structures.
Reticulum cell sarcoma. Histocytic lymphoma. Non-Hodgkin's lymphoma.	All ages. 20-50 y.		Long bones.	Diaphysis. (medulla) Metaphysis.	✗	✗	Round cells with reticulin fibers.		No general future. Glycogen (-) Reticulin fibers stained by silver stain. Pathological # common.

Malignant Bone Lesions

Tumour	Age	Sex	Type of bone	Where is the lesion in the bone	Bone reaction	Calcification	Predominant cells	X- Ray	Notes
Multiple Myeloma.	40-60 y.	M: F 1:1	Bones with excessive bone marrow.	Anywhere.	✗	✗	Plasma cells like.		Radiosensitive.

P.O.P Application Technique

1. What is the plaster of Paris?

It is the hemihydrated calcium sulfate reacted with water to form hydrated calcium sulfate. This reaction is exothermic i.e, produce heat.

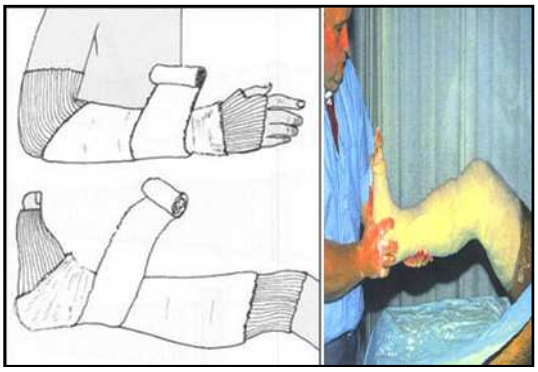
2. Types:

Round form	Strip form
Casts.	Splint
Cylinders	Gutter like
Spica	
Jackets	
Hallo pelvis	
Collar	

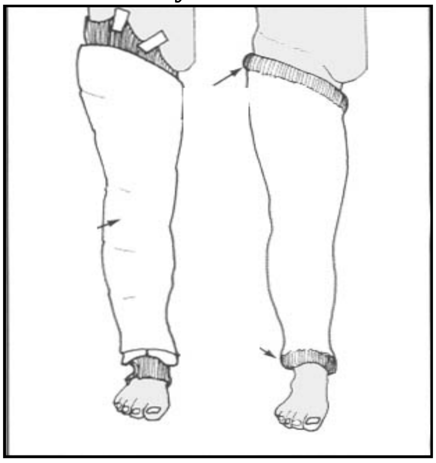
- Slab: is p.o.p that covers 3 aspects of the affected limb. "Gutter like slab".
- Slab splint: that only covers one aspect.
- Spica: that covers the affected limb with part of the trunk.

E.g.: Hip spica, thoracobrachial spica

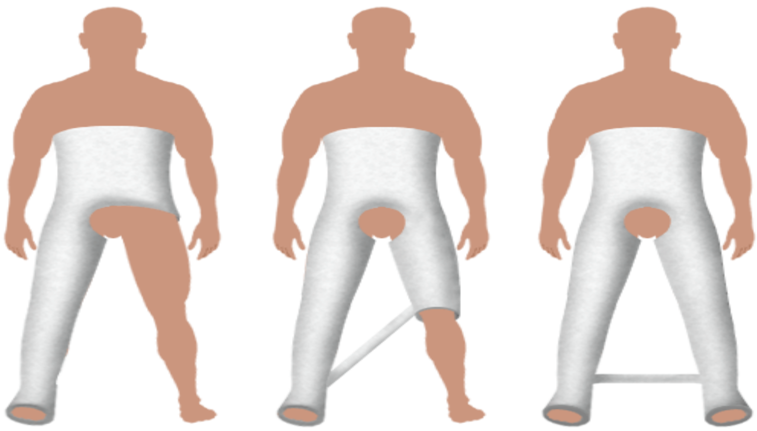
Cast



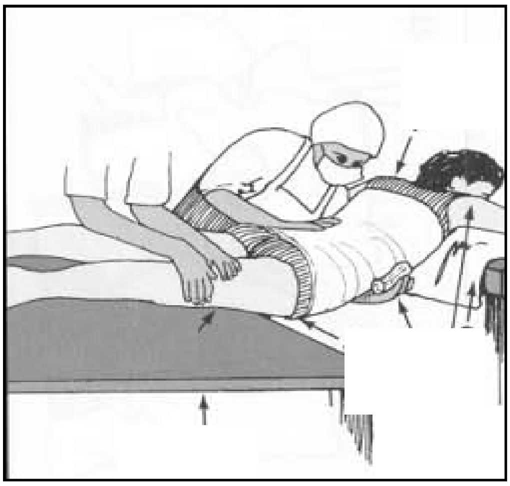
Cylinders



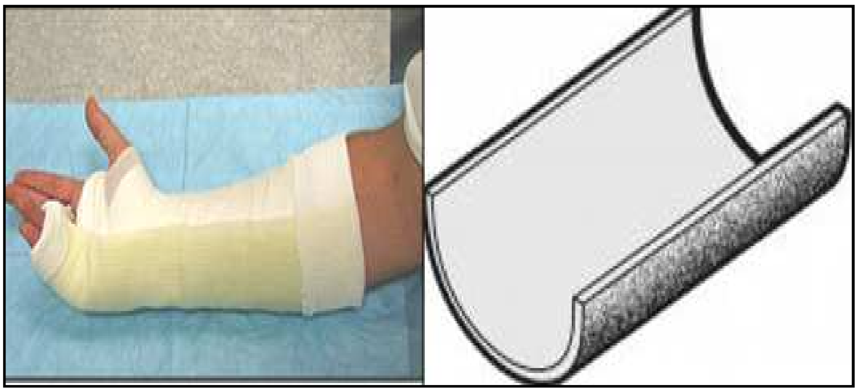
Spica



Jacket



Gutter



Splint

3. How to apply P .O.P?

Protection of the skin:

By using stockingnet or cotton, wool prior to apply the p.o.p you should

protect the skin from direct pressure of the p.o.p especially against bony prominants by one layer or more of cotton.

4. How many layers?

As a general rule 7-10 layers in adult 6 layers in children. But the layers should be applied according to the weight and built of the patient.

They roughly not less than 6 layers in the upper limbs and more in the lower limbs.

5. How to apply the bandage on the patient?

On applying the bandage on the patient make sure that each layer covers two thirds of the under laying layer, starting from distal to proximal.

6. What water can be used?

Cold water = if we want to perform manipulation after applying p.o.p (Room temperature).

Hot water= if we want fast hardening.(worm)

7. How long we let p.o.p in water?

Until the bubbles disappear or as instructed in the p.o.p (6 seconds)

8. What are the available size of p.o.p?

The following sizes of plasters bandage are recommended for normal applications:

- Upper arm and forearm ....15 cm or 6 inches
- Wrist. ....10 cm or 4 inches
- Thumb and fingers .... 7.5 cm or 3 inches
- Trunk and hip .... 20 cm or 8 inches
-Thigh and leg .... 20 cm or 8 inches
- Ankle and foot .... 15 cm or 6 inches

9. How to apply the p.o.p on the affected limb?

- ***Upper limb***

- o P.O.P around wrist and hand:

  The p.o.p should start from just proximal to the distal palmer crease and along it's obliquity and extended to just distal to the flexor elbow creases.

- o Fractures of the mid-shaft of forearm:

  starts from the same point to the midpoint of the arm.

- o Fractures of the upper forearm:

  starts from the same point to the upper 1/3 of the arm.

(mid-mid) (upper-upper ...)

- Position of the upper lime in p.o.p:

- If the fracture around the wrist: it is preferable to keep the forearm in pronation position.
- If it is in the middle of the forearm put the forearm in the mid-way position(between pronation and supination).
- If the fracture in the upper third of the forearm put it in supination position.
- If it is above the elbow-make thoracobrachial spica, or U-shape or hanging cast.
- In all cases, the wrist should be kept in extension as (clinched fist).while the elbow in 90 flexion (with exceptions).
- Position is determined by the mechanisms of the muscle action in the affected part.

***Lower limbs**:*

- Fractures of the foot and around the ankle, p.o.p start from just proximal to the neck of metatarsal bones to just distal the neck of fibula" to prevent the compression of the common peronial nerve"
- Fractures at the middle of the leg, from the same point to the mid-point of the thigh.

9.

- Fractures at the upper third of the leg, from the same point to the upper third of the thigh.

(mid-mid)   (Upper-upper ...)

- Fractures above the knee make hip spica.

- ***Position:***

  - The ankle in 90° dorsiflexion (plantegrade).
  - The knee at 10-15 flexions.

10. Slab or Cast?

The aim is to prevent compartment syndrome i.e.: in cases where we suspect increasing the size due to edema, soft tissue swelling " haematoma" this may occur:

- Immediately after trauma.
- Postoperative.

Applying this method only for 3-4 days, then completion into a cast.

N.B. If the slab is performed, and the process of healing is going well, let the slab till the end of union. This may occur in fractures like green stick fractures in children.

11.Instruction

To the patient in p.o.p

1- If the finger or toes become swollen, blue or painful-rise the limb.

2- If not improved ½ an hour later, call the doctor or return to the hospital immediately.

2nd 1- Exercise all the joints not included in the p.o.p. especially fingers and toes.

11. 2- If you have been fitted in a walking plaster walk on it.

3- If the plaster becomes loose or cracked, report to the hospital as soon as possible.

12.When the plaster should be removed?

If the fracture consolidated (according to the type of fracture, the site and the age of the patient).

Time Table:

How long dose a fracture take to unite and to consolidate, precise answer is not possible because age, constitution, blood supply, type of fracture and other factors all influence the time taken. Approximate prediction is possible and Perkins's timetable is delightfully simple.

A spiral fracture in the upper limb unite in 3 weeks, for consolidation multiple by (2) again. For transverse fracture, multiply again by (2). In adults multiply by (2) again.

Union is incomplete repair, the unsheathing callus is calcified.

Consolidation is a complete repair, the calcified callus is ossified.

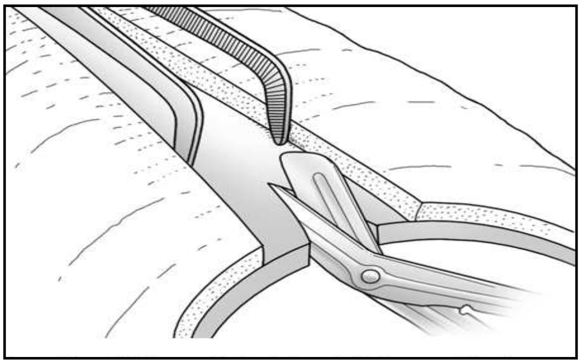
13.How to open the p.o.p?

- Plaster scissors.
- Plaster shears.
- Plaster saw.

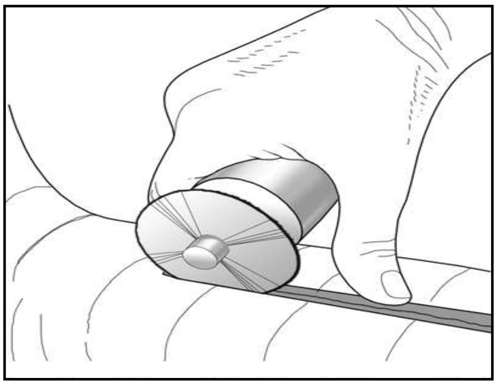
Figure 8. Types of Upper-Extremity and Lower-Extremity Splints.
Panel A shows a volar splint, Panel B an ulnar gutter splint, Panel C a thumb spica splint, Panel D a long-arm splint, Panel E a sugar-tong splint, Panel F a posterior-leg splint, and Panel G a posterior-leg splint with a stirrup.

Ulnar POP Gutter

Forearm POP Casting



Plaster Scissor



Plaster Saw